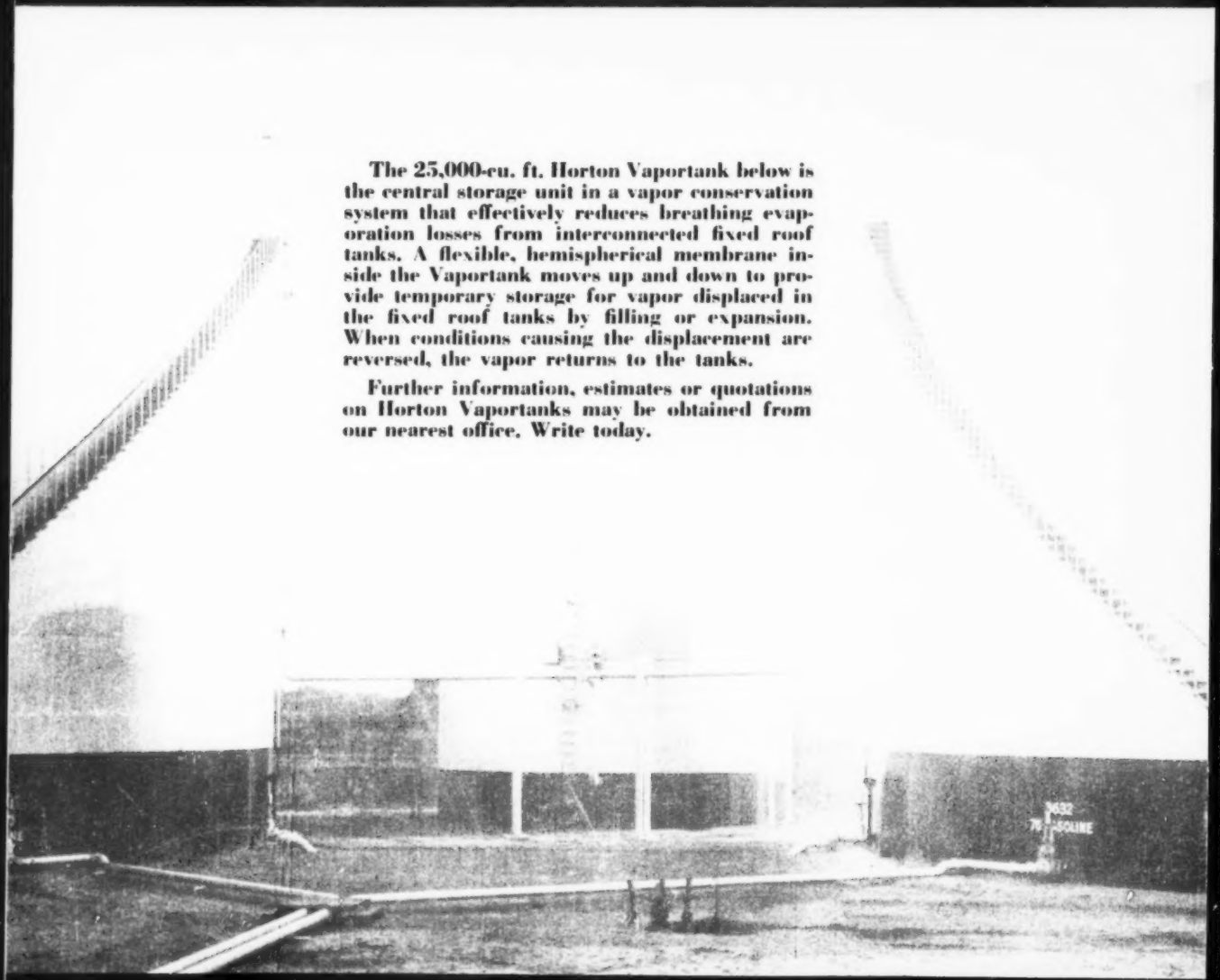
Natural Gasoline
Special Issue

PETROLEUM REFINER

REFINING | PETROCHEMICALS | NATURAL GASOLINE

The 25,000-cu. ft. Horton Vaportank below is the central storage unit in a vapor conservation system that effectively reduces breathing evaporation losses from interconnected fixed roof tanks. A flexible, hemispherical membrane inside the Vaportank moves up and down to provide temporary storage for vapor displaced in the fixed roof tanks by filling or expansion. When conditions causing the displacement are reversed, the vapor returns to the tanks.

Further information, estimates or quotations on Horton Vaportanks may be obtained from our nearest office. Write today.



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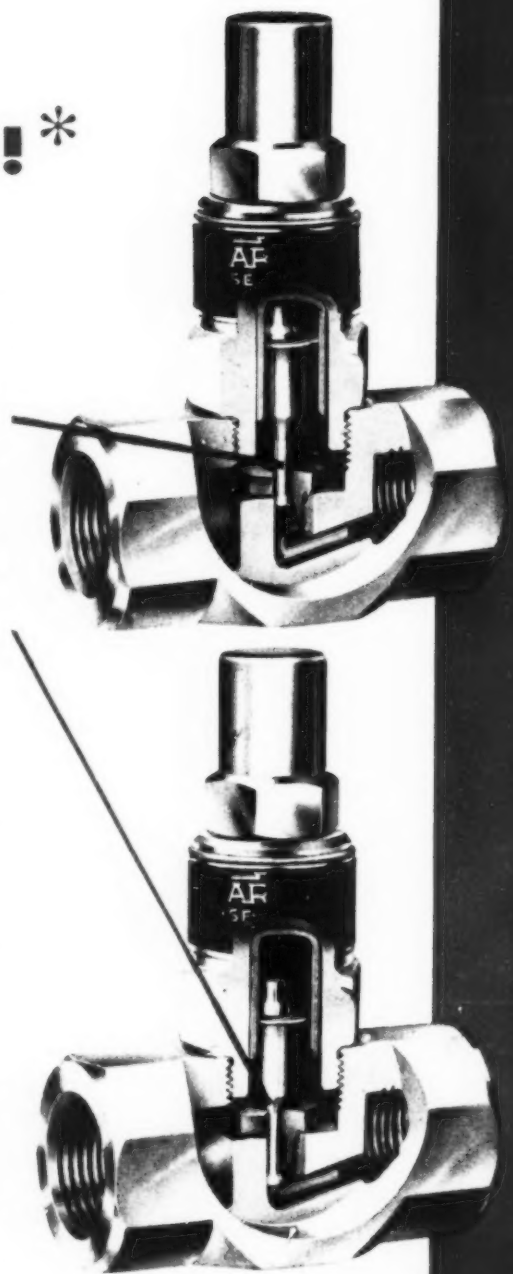
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, and GREENVILLE, PENNSYLVANIA

IT FLOATS ON THE LOAD!*



You turn on the steam.

This little stainless steel valve—the only moving part in the Yarway Impulse Steam Trap installed on the equipment—opens wide and *stays* open as the air and condensate continuously pour through.

The equipment reaches production temperature in the quickest possible time.

Production temperature reached, the little valve snaps shut. After that, by a pulsating action, it discharges all condensate as it forms—even a tiny teaspoonful. *There's hot steam in the equipment all the time . . .* steady, maximum temperatures are maintained.

It all adds up—to more production per day.

Other profit-making features of the Yarway Impulse Steam Trap—low initial cost, easy installation, stainless steel construction, low maintenance, good for all pressures, quick delivery from over 200 local industrial distributors.

Try a Yarway—free for 60 days—and *prove* its advantage. Your distributor will supply you.

For free Yarway Impulse Steam Trap Bulletin T-1740, write . . .

YARNALL-WARING COMPANY
128 Mermaid Ave., Philadelphia 18, Pa.

*. . . *resulting in fast heat-up of equipment, more production per day.*

YARWAY | ***impulse steam trap***

PETROLEUM REFINER
REFINING | PETROCHEMICALS | NATURAL GASOLINE

Volume 33, No. 4 April, 1954

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A Quick Look at This Issue

NATURAL GASOLINE SPECIALS

- **Do Gasoline Plants Pay Out? . . .** This exclusive interview with a gasoline plant specialist answers some poignant questions on gasoline plant economics. He answers the $64 question: are we reaching the point where there isn't enough difference between the price of the unprocessed gas and the gas converted to liquid through a plant process to justify installation of a plant. **Page 112.**

- **Low-Temperature Process Advances . . .** Addition of a stabilizer to low-temperature separation units can increase yields of retrograde condensate. Hints are outlined in this article for making your own tests on comparative condensate recoveries. **Page 115.**

- **Orifice Meter Accuracy . . .** Here's a perennial problem and we've got the answers for you in pictorial form which will be clear to every man in your plant. With gas prices what they are today, measurement can stand some re-examination. **Page 118.**

- **Water Problems and Their Solutions . . .** You'll like this approach to one of industry's most perplexing problem—water. This series will get right down to what goes on in the water—quite a departure from the common equipment approach. Water supply and quality are discussed in the first part of this handbook. **Page 122.**

- **Vapor Phase Engine Cooling . . .** Engine jacket cooling is experiencing a revolution in California. The method, termed "vapor phase cooling," utilizes water at its boiling point, thus taking advantage of the large latent heat of vaporization. The steam so produced can be put to convenient use. **Page 127.**

- **Low Temperature Distillation . . .** This simplified apparatus fills the need for an inexpensive laboratory distillation unit where infrequent analyses are required. It reverses the trend toward greater automaticity that we've seen in the development of low temperature fractional distillation equipment. **Page 132.**

- **Corrosion in Sweetening Units . . .** In dollars and cents, this report spells out the corrosion associated with two solid-bed treaters. What is the range of corrosion you can expect in these treaters? These experiences gave two answers. **Page 135.**

Turn Page

A Quick Look at This Issue

• **Natural Gasoline Production Remains High . . .** Don't look for a big increase in natural gasoline production this year. Production will remain high, but upward trend is about static. The gas industry will continue its amazing growth and new reserves will still keep ahead of production. **Page 138.**

• **What Trade Associations Are Doing . . .** You might be missing a bet by not following the technical committee work of NGAA and CNGA. They both work on some knotty problems. One of them might be yours. **Page 140.**

• **Natural Gas Correlations . . .** If you are plagued with verifying natural gas analyses in your laboratory, here is a quick method to solve your problem. The author bases his work over the range of three years and 1000 gas analyses. An added development permits the close approximation of gasoline content in a gas sample with only the heating value and specific gravity determinations actually being made. **Page 142.**

Some Proposed Taft-Hartley Changes Are Dangerous to Oil . . . In the Congressional hopper are several bills which would amend the Taft-Hartley Act. Some are good, and some – particularly those dealing with secondary boycotts – are inimical to industry. Here, in easily read, question-and-answer form, are some of the things you should know about this important legislation – and what you should do about it. **Page 106.**

How Old Is TOO OLD? . . . Every successful operator knows the value of full use of his machinery. But how many utilize to the fullest their employes—particularly the older ones? Many firms are re-examining their mandatory retirement programs in light of proven facts that older men are capable of learning new techniques and are definitely more reliable and punctual. Experience and training are more important than physical strength and endurance, declares the author of this thought-provoking article on **page 107.**

Dualayer Gasoline Treating Process . . . This treating process takes a revolutionary step in mercaptan extraction by utilizing the two immiscible layers of caustic solutions containing organic acids. By so doing, 100 percent mercaptan removal is accomplished. Other applications of this principle are in the making. **Page 150.**

Ultraforming—New Reforming Process . . . This catalytic process takes advantage of the high yields and octane numbers offered by operation at low pressure. The platinum-on-alumina catalyst is maintained at high activity by a novel regeneration technique that goes beyond mere carbon removal. The process favors the conversion of paraffins to aromatics, giving good results even with charge stocks low in naphthenes. **Page 153.**

Addition of Acids to Olefins and Acetylenes . . . Here is another in the refresher series, "Understanding the Chemistry of Petrochemical Reactions." This paper, Part 11, discusses the chemical reactions involved in some of the more important commercial processes where acids are combined with olefins or acetylenes. The products formed are usually intermediates in the production of other compounds such as tetraethyl lead, ethyl cellulose, ethylene oxide and glycol. Brush up on this phase of petrochemistry by turning to **page 157.**

Radio Solves Many Maintenance Problems . . . Rapid communications by means of shortwave radio can aid you in plant maintenance. It allows you much better use of manpower and equipment, and provides a plant with a tailor-made communication system in the event of an emergency. **Page 161.**

Unifining . . . This catalytic hydrogenation process can clean up a variety of refinery stocks by nearly complete removal of sulfur, nitrogen and metals. It's applicable to a variety of stocks, including gasoline, middle distillates and gas oils. There's little or no loss in yield. **Page 165.**

New Pebble Heater Process . . . Just announced by Phillips Petroleum Company, this new process promises higher yields of ethylene and acetylene from the cracking of light hydrocarbons. New features are higher temperatures, shorter contract times, and lower pressure. For a full description, including flow diagrams and yields, turn to **page 171.**

Petrochemicals from Refinery Coke . . . Here's a fresh approach to the old problem—upgrading refinery products to increase their value and to find more stable markets. A lot of people are convinced of the value of converting some of their fuel oil stocks to coke, as evidenced by the number of coking units in operation today. The motive, of course, is to increase profits. This article discusses the possibility of upgrading coke to calcium carbide and subsequently to acetylene. Included in the discussion are some of the economics on the coking and carbide processes, a description of the carbide process, and the possibilities resulting from the acetylene which can be produced. **Page 175.**

Where's the Fire? . . . Continuing the basic series on fire extinguishment throughout various refinery installations, Part II discusses sphere top fires in step-by-step fashion. **Page 257.**

Gulf Officials Speed Reading, Save Money . . . It costs $50 to $75 a week for an executive to read the reports, memos and correspondence which cross his desk. If he can be taught to read twice as fast, a considerably savings are effected. Here's how it's done. **Page 276.**

Readers' Service Cards . . .

New Equipment Section starts on page 305. Immediately following are the Readers' Service Cards designed to bring directly to you data on (1) new equipment or literature reviewed in this issue and/or (2) more information on any product advertised. Use these postcards for quick service.

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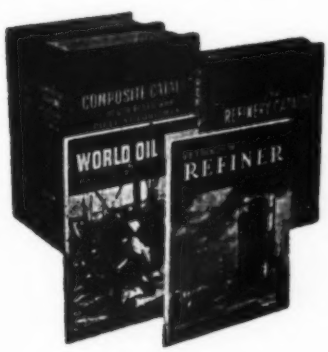

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PETROLEUM REFINER and The REFINERY CATALOG for the refining-natural gasoline-petrochemical industry

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Bob's B. S. & W.

Oil Industry Public Relations are Terrible! And if you don't think so, take a look at some of these ideas unearthed in the public opinion survey conducted by Opinion Research Corporation at the behest of the Oil Industry Information Committee: (1) We're monopolistic—only 50 percent of the nation's population believe our industry is highly competitive.

(2) Majority thinks gasoline prices are too high, even though they are lower than the average of *all* consumer items, according to recent indices.

(3) Nearly two-thirds of the people in this country believe the rumors that the oil industry deliberately buys up and suppresses inventions which save gasoline. This in spite of the fact that the industry spends $100 million a year on research.

There were positive results from the survey. The consumers like service station managers, and about one-half of the public realizes that there have been improvements in gasoline quality in the last five or six years.

To me the results of this survey were absolutely staggering. The news release from the API did its best to present the results in the happiest possible light, pointing out that in many cases people thought better of us than they did in 1950 when a similar survey was made. Thus the efforts of OIIC have not been fruitless and some headway apparently is being made. But the fact remains that the populace as a whole does not understand us, has no comprehension of the fiercely competitive nature of our business, and in general doesn't think well of us at all.

Where does the fault lie and what can be done? It's hard to point a finger—we'll all share the responsibility. Plenty can be done. First, sell our industry to ourselves—indoctrinate thoroughly plant workers in the unvarnished facts of our business. Pour on the steam toward such public relations programs as sending speakers to civic groups. Empower the public relations departments of individual companies with sufficient authority to really do a job of selling. Overcome the notorious skittishness of oil companies to release information on their own activities. Play up heavily the technical achievements of the industry (the chemical companies have done this very successfully). But win, lose, or draw, do something! It is tough to be a stinker, but it's far worse to be thought a stinker when you aren't one.

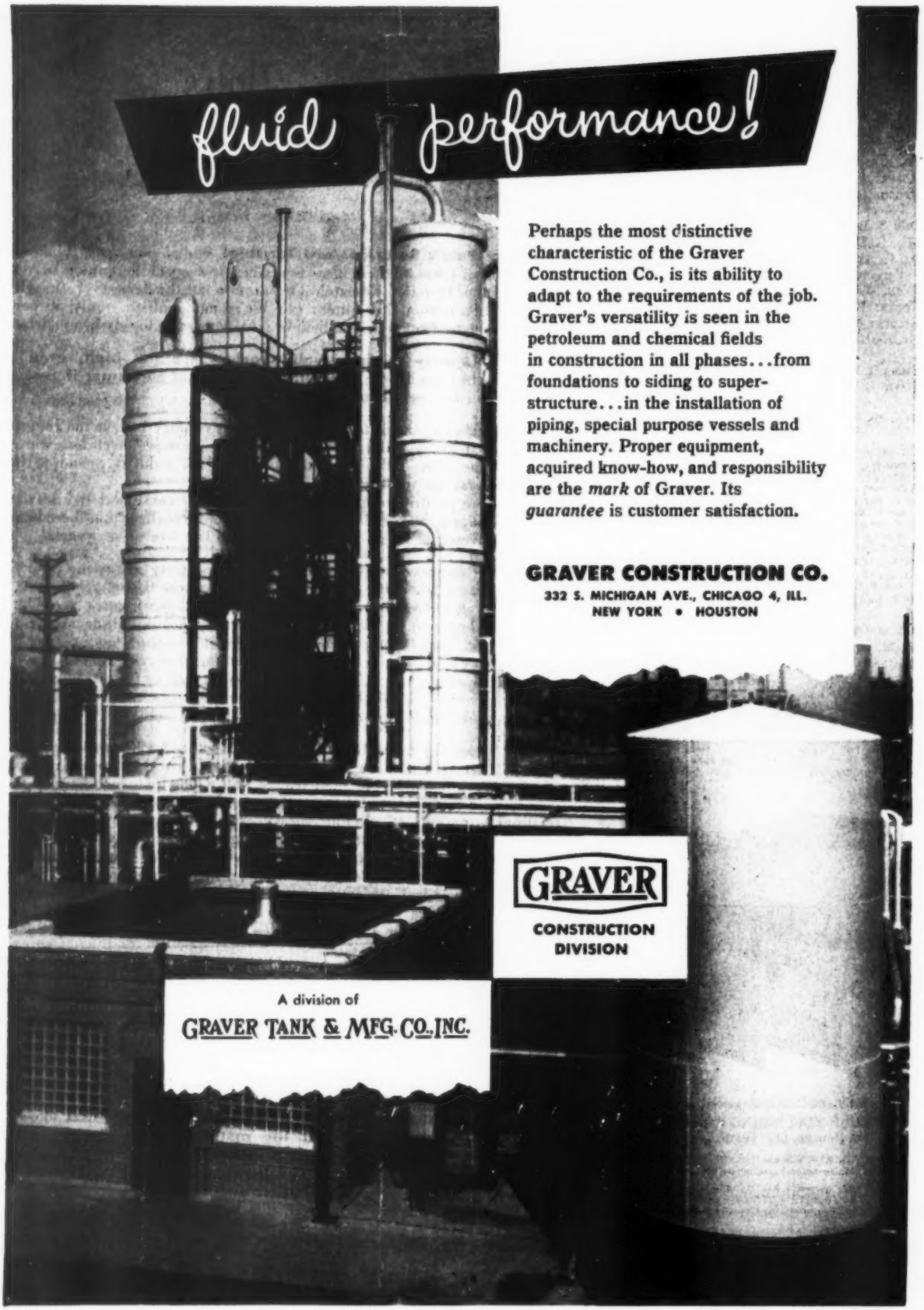
* * *

Buck Buys Big Bargain. We don't mind telling anybody that the REFINER was the first petroleum publication to "get with" the current hue and cry over maintenance and maintenance costs. Only recently jarred out of an antiquated idea that maintenance was art rather than science, refinery managers have been deciding that here was a tail that wagged the dog.

We've been trying to do our little bit with some first class helpful articles beamed at the maintenance engineer and supervisor. This effort was highlighted with the Maintenance Special Issue, published in the January REFINER.

Which brings us to the point of this little piece: you can be one of 376 lucky owners of a special reprint of that edition if you shoot off one dollar to our Reprint Department right away quick.

—*Bob Phillips*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Perhaps the most distinctive characteristic of the Graver Construction Co., is its ability to adapt to the requirements of the job. Graver's versatility is seen in the petroleum and chemical fields in construction in all phases...from foundations to siding to superstructure...in the installation of piping, special purpose vessels and machinery. Proper equipment, acquired know-how, and responsibility are the *mark* of Graver. Its *guarantee* is customer satisfaction.
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What one tube steel will give you the best life/cost ratio? *Ask the experts!*

This month's report is on:

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Has unusually high creep strength for a pearlitic steel, good stability up to 1200°F., fairly good corrosion and oxidation resistance. Has 2 to 3 times the life of carbon steel where corrosion is not severe. Recommended for cracking furnace tubes, hot oil lines, superheater tubes, high temperature steam piping and forgings for accessory parts.

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DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

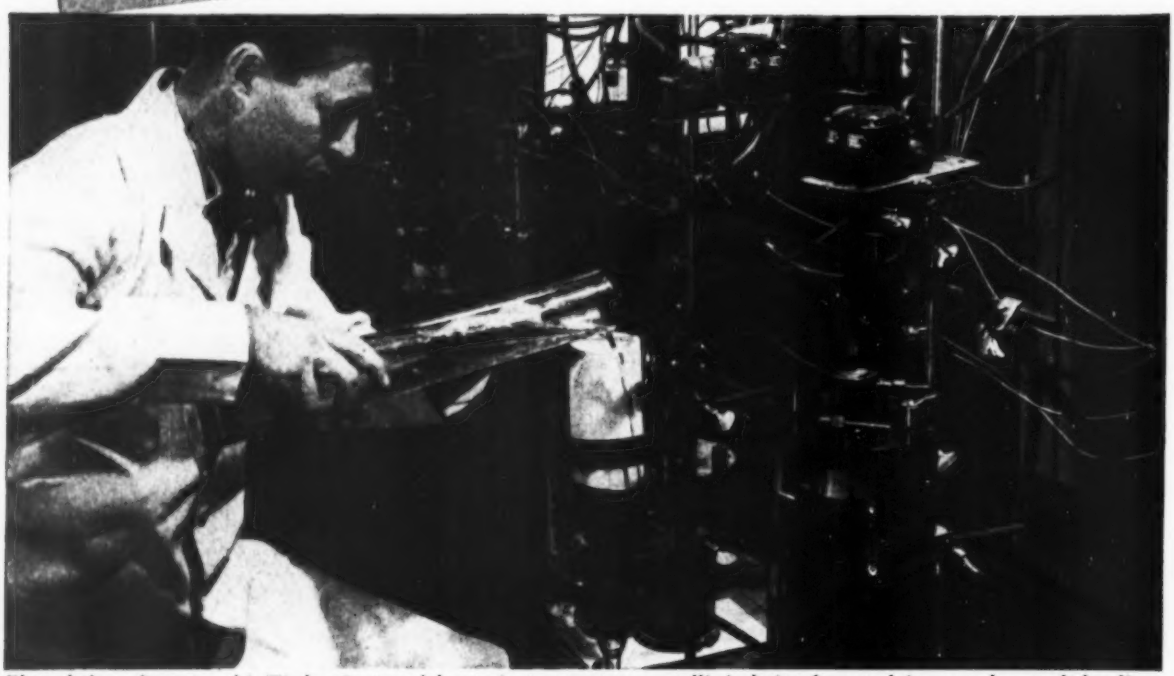
*Available as seamless tubing on an experimental basis only.
**Not available as seamless tubing.

THERE are probably several high temperature tube steels that will solve your heat, pressure, corrosion and oxidation problems. But there's only one analysis that will give you maximum tube life per dollar.

To find it, *ask the experts!*

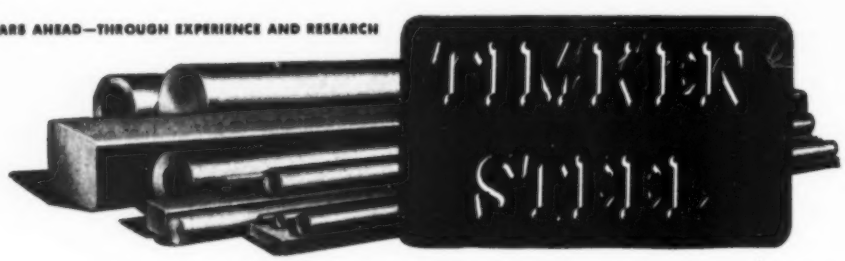
With over 20 years of steel research and experience, Timken Company metallurgists are recognized authorities on high temperature steels. They'll use this experience to help you select from 24 different analyses, pick the one tube steel that will give you the best life/cost ratio. And regardless which analysis you select, you'll be assured of uniform quality because the Timken Company rigidly controls quality from melt shop through final inspection.

Let the Timken Company's RSQ—Research, Supply, Quality—solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".



Electrolytic equipment used in Timken Company laboratories to extract non-metallic inclusions from steels in research on steel cleanliness

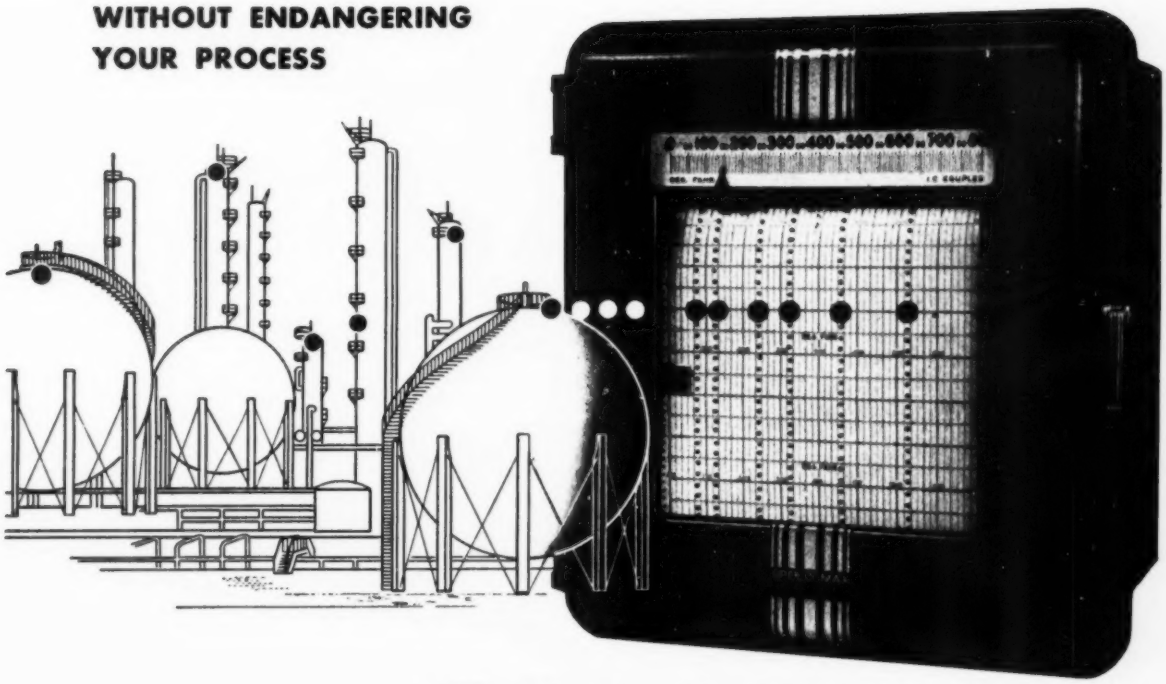
YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

HOW TO CENTRALIZE OPERATING DATA *and save money*

WITHOUT ENDANGERING YOUR PROCESS



In as little time as 2 seconds per point, Speedomax Multiple-Point Recorders centralize data about temperatures or other conditions scattered throughout process units.

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In addition to this recording speed, other features give superior performance. A soundly-designed amplifier and electronic circuit assure unusual accuracy and sensitivity over range spans as narrow as 100 F. Instrument performance is unaffected by vibration. The quantity measured may be temperature, pH, speed, weight or electrical load.

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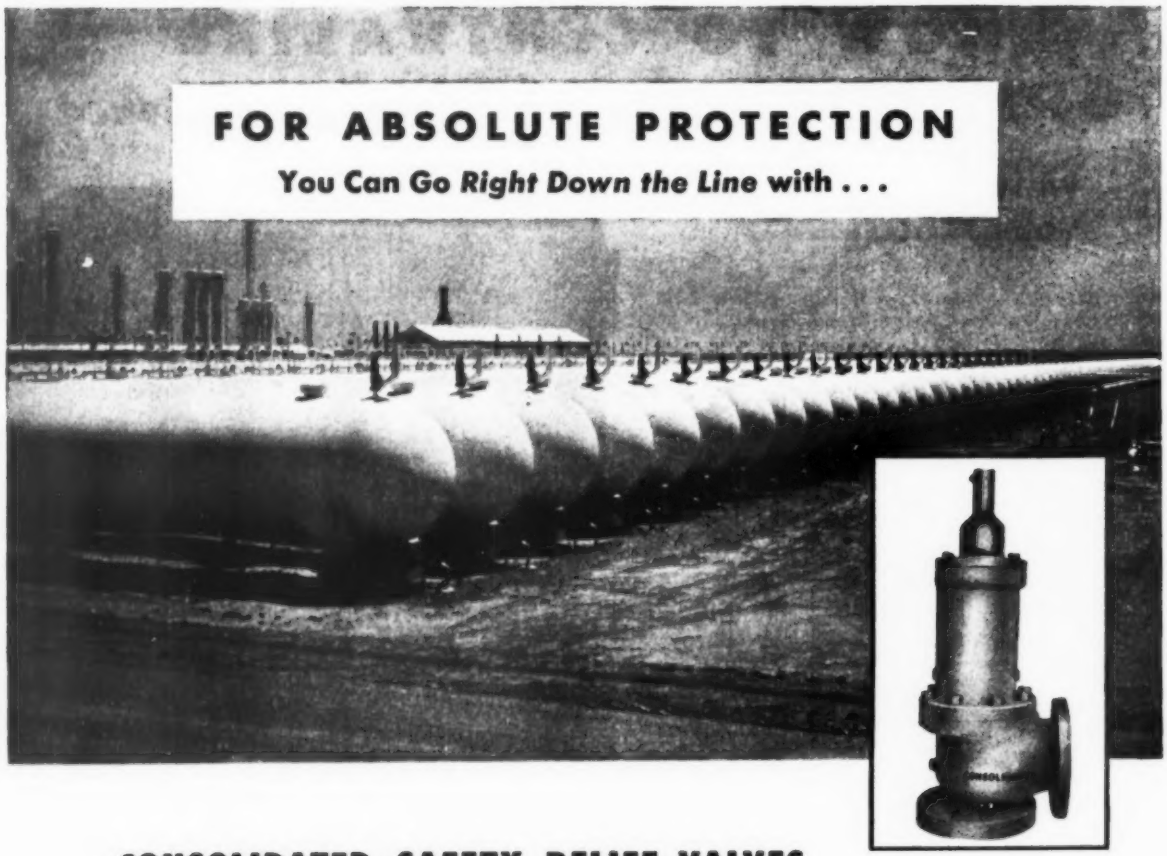

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COMPLETE PROTECTION for personnel, property and equipment rates top priority in safety engineering wherever industry must confine gases, vapors and liquids in unfired pressure vessels. That is why Consolidated Safety Relief Valves are such a common sight on processing facilities, pipelines, pumps and storage tanks.

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Input pressures vary from 10" vacuum to 10 psi for this operation, and corresponding outputs are in the 60 to 75 psi range. Depending upon gasoline plant operations, from 650,000 to 1,000,000 cu. ft. per day of gas is handled by each unit.

According to Mr. G. R. Paull, Manager of Nash Gasoline Company, the consistently good performance which the company has received from these units, together with low maintenance costs throughout the three-year period these units have been in service, was directly responsible for their decision to re-order additional "Oilwell" units for their expanding facilities.

When you have GAS PUMPING Problems

. . . let your "Oilwell" Representative quote on the "Oilwell" Unit that meets your requirements most economically, throughout the 20 to 300 hp range.

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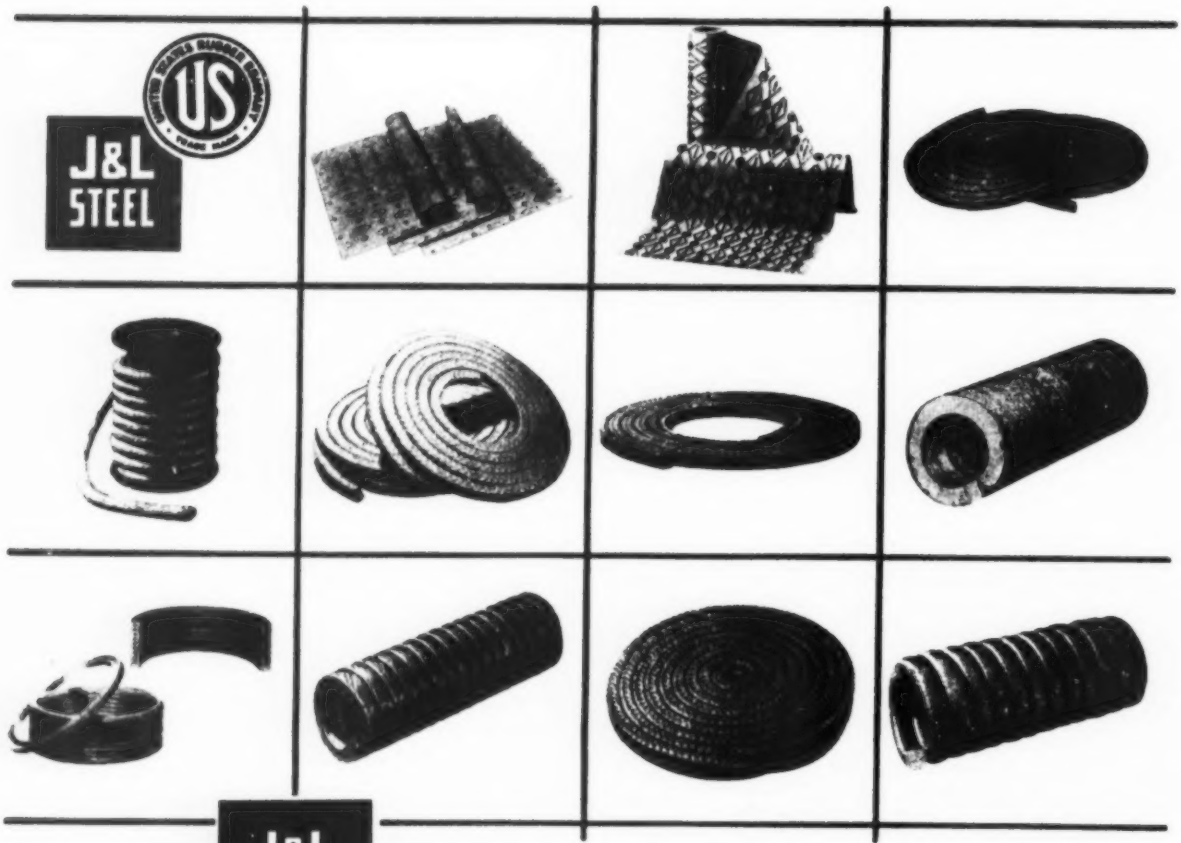

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Jones & Laughlin
STEEL CORPORATION
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Serving The United States and Canada

For more data on advertised products, use Readers' Service Cards, last page.

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By Heat Exchanger Specialists

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Ivy covered walls for better HEAT EXCHANGERS

In an effort to add to the knowledge and technology of heat transfer, Western Supply sponsors research at the internationally known Petroleum Sciences College at the University of Tulsa. Heat transfer rates are carefully studied using various fluids under a wide range of temperatures and pressures. With equipment installed by Western, students and professors may study boiling, condensing, forced convection transfer rates and fouling characteristics.

This, however, is but one phase of Western's continuous research program. In addition, the company is an active participant in the studies of the Tubular Exchanger Manufacturers Association. For several years TEMA, in cooperation with other technical groups, has been conducting tests on shell-side transfer rates using equipment installed at the University of Delaware. Metallurgy, too, is studied by Western technicians and an experienced metallurgist of over 25 years experience consults daily with Western Engineers on welding, heat treating and corrosion problems as well as exchanger structural design.

The above is a brief summary of Western's research program . . . a program designed and carried on to offer you, the customer, the benefits of better design, better construction for increased operating efficiency and longer life for your Western Heat Exchangers.

Third in a new series of advertisements

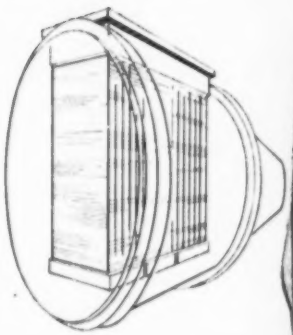
WESTERN
HEAT EXCHANGERS

WESTERN SUPPLY CO.

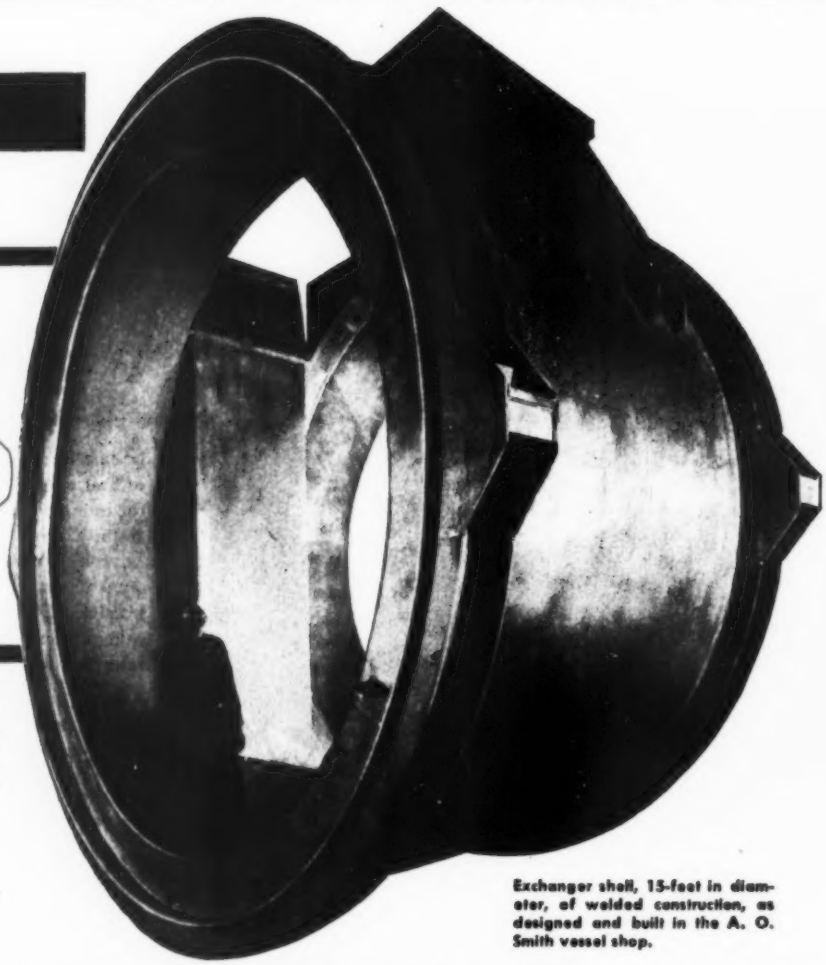
P. O. BOX 1888 • TULSA, OKLAHOMA

A.O.Smith for

VESSELS



Sketch shows general arrangement of assembled exchanger. Tube bundle is installed through rectangular opening in the top on which tube sheet rests.



Exchanger shell, 15-feet in diameter, of welded construction, as designed and built in the A. O. Smith vessel shop.

COOLER FOR GAS

A case history of A. O. Smith design, engineering and manufacturing skill

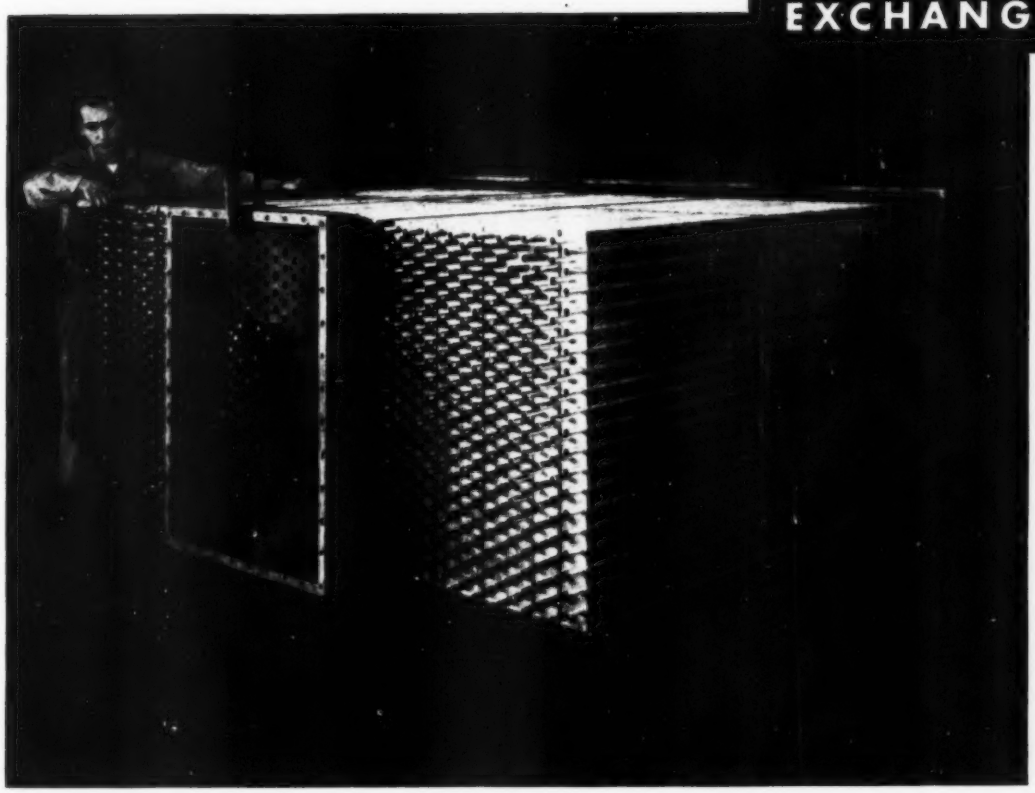
It required the combined pressure vessel and heat exchanger shops of A. O. Smith to produce this, and similar coolers, for the Gas Dynamics Facility of the Arnold Engineering Development Center at Tullahoma, Tennessee. They will cool air for a supersonic wind tunnel. Thermal capacity of this cooler is approximately 85,000,000 BTU/hr. It is designed for 140 psi on the water side, full vacuum on the air side, and to handle as much as 1,890,000 pounds of air per hour with inlet temperatures as high as 410° to 435° F.

The shell, above, is so big and tolerances so exacting that its construction required the services of a manufacturer with a proved record of diverse vesssel experience to fabricate it. It is a weldment, 15 feet in diameter. Yet, maximum out-of-round tolerance is but ¼ of wall thickness and the ends of the vessel are perpendicular to axis within −0° 10′. Clearance between baffles and the tube bundle, when installed, is held to 0.125 inch to prevent air by-pass.

Few manufacturers can take on the responsibility for such a vessel and at the same time provide the equally exacting tube bundle which it houses.

Outstanding Advantages

EXCHANGERS



Tube bundle for exchanger as designed and built in the A. O. Smith heat exchanger shop.

DYNAMICS FACILITY

The tube bundle, providing approximately 80,000 square feet of outside surface, is made up of ¾-inch tubes and aluminum fins spaced 12 to the inch, mechanically bonded to the tubes. Multiple floating heads, of A. O. Smith design, assure freedom from thermal stress, meet the extreme operating conditions in service and permit ready accessibility for replacement of a portion of the bundle or individual tubes.

This outstanding example of vessel and exchanger fabrication in one shop reveals the capacity of A. O. Smith Corporation to satisfy your most exacting pressure vessel and heat exchanger problems. Opportunities are invited to assist in planning, designing and fabricating complete vessels and thermal transfer units. Inquiries will receive prompt and expert attention.

For glass-lined process equipment, contact
GLASCOTE PRODUCTS, INC.
Cleveland 17, Ohio
A new A. O. Smith subsidiary

A.O.Smith
CORPORATION
MILWAUKEE HOUSTON LOS ANGELES
INTERNATIONAL DIVISION: Milwaukee 1, Wis.

For more data on advertised products, use Readers' Service Cards, last page.

How would YOU solve these two problems?

1. MEN AND WOMEN BOTH like nylon fabrics. Important key to producing successful nylon fabrics is the heat-setting process. Temperature-control must be accurate, and reliable yet readily adjustable. "National" Nylon Heat Setting Machines used by the leading textile mills employ THERMOSWITCH® units in the heated rollers . . . get highest efficiency . . . greatest safety . . . most economical fuel consumption.

2. BABY INCUBATOR MUST BE SAFE. Engineers who design Armstrong Baby Incubators say "Safety is a *must* where babies are concerned. That is why all our baby incubators are tested and approved by Underwriters Laboratories. That is why we use only Fenwal THERMOSWITCH units to control all-important temperature and humidity. Inspection reports on more than 22,000 THERMOSWITCH units show a remarkable picture of consistent reliability."

3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature problems and helping to improve the final product throughout all industry.

4. SEND FOR THIS BROCHURE for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Incorporated, 104 Pleasant St., Ashland, Massachusetts.

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*

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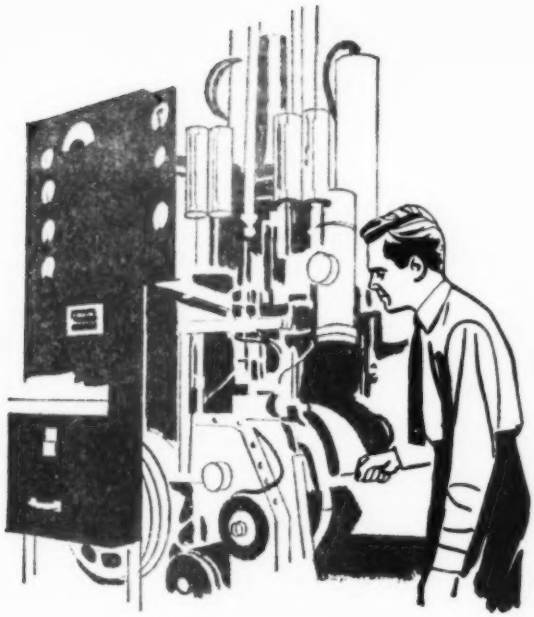

If you'd like to

add 3 OCTANE NUMBERS try...

AEROCAT®

MS SYNTHETIC CRACKING CATALYST

Recently 42 cat crackers reported to Cyanamid the results of their cracking operations: Units on natural catalyst were getting an average of 90.5 octane (research clear). Those on AEROCAT were getting an average of 93.1 octane (research clear).

Which indicates again that where high octane is the order, AEROCAT is the answer.

This alone, of course, does not account for the fact that *among all cat crackers now using synthetic, 8 out of 10 use* AEROCAT. They use AEROCAT because:

1 AEROCAT is the surest, most economical means not only to high octane but also to

- high throughput
- low CO_2/CO ratio in flue gas
- high isobutane yield
- excellent heat, steam and sulfur stability

2 AEROCAT is a product of American Cyanamid Company – which has the research facilities, the technical service staff, and the experience required to develop solutions to individual application problems.

3 Cyanamid can be relied upon as a source of supply.

How about your own cracking operations? Are you getting 93 octane . . . plus the many other AEROCAT advantages? If not, write or call Cyanamid's Technical Service representative.

AMERICAN Cyanamid COMPANY

REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza, New York 20, N.Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

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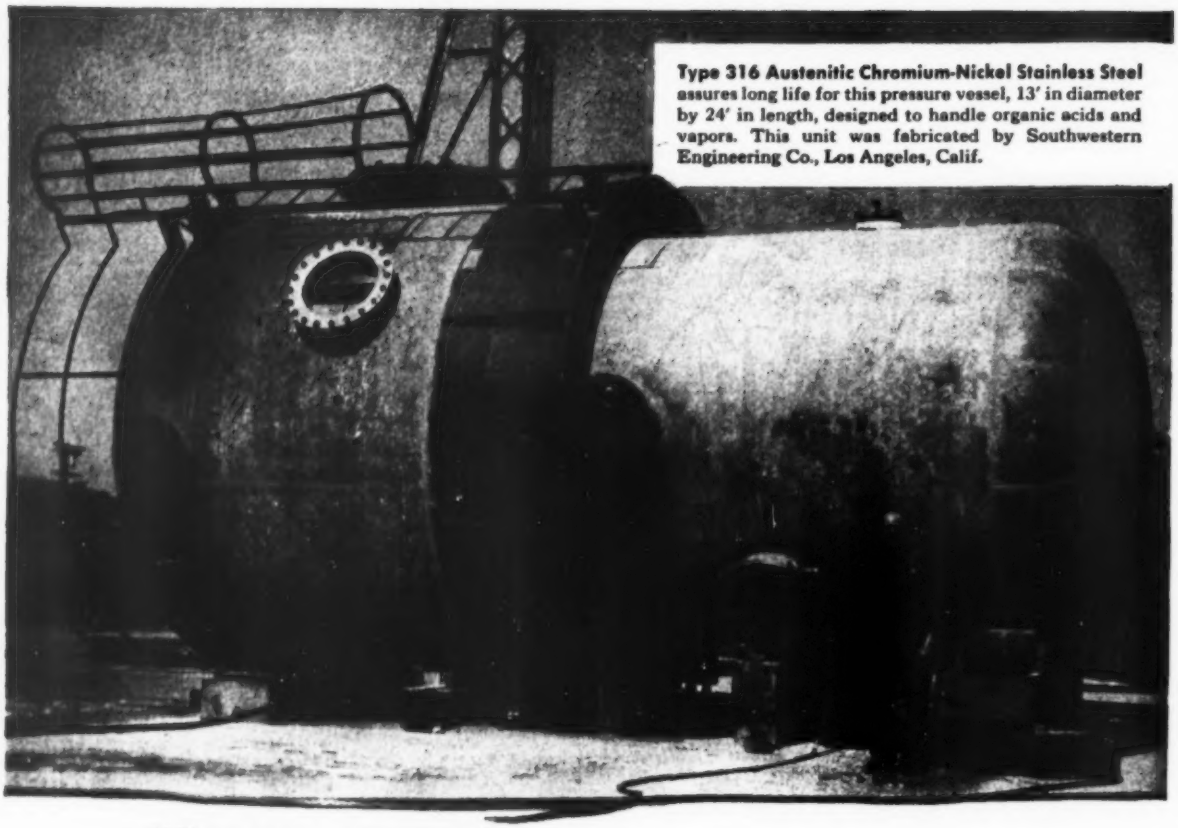


Type 316 Austenitic Chromium-Nickel Stainless Steel assures long life for this pressure vessel, 13' in diameter by 24' in length, designed to handle organic acids and vapors. This unit was fabricated by Southwestern Engineering Co., Los Angeles, Calif.

Wherever you need

Exceptional corrosion resistance and improved creep strength...

Investigate Type 316 Stainless Steel . . .

It resists attack by organic acids, weak sulphurous acid, carbonic acid solutions and weak mineral acids. Also . . . to a good degree . . . sea-water.

The pressure vessel, shown above, is a typical application of Type 316 Stainless in the petrochemical industry where it is widely used to provide:

Resistance to corrosion (particularly, pitting)

Improved mechanical strength (particularly at elevated temperatures)

Ease of fabrication

Maximum economy per dollar

Increased equipment life

Type 316 Stainless contains 18 per cent chromium, 13 per cent nickel and 2 per cent molybdenum. It is one of some 30 alloy steels which qualify to carry the family name "Stainless" by virtue of their resistance to attack by chemicals and atmospheres over a wide range of concentrations, pressures and temperatures.

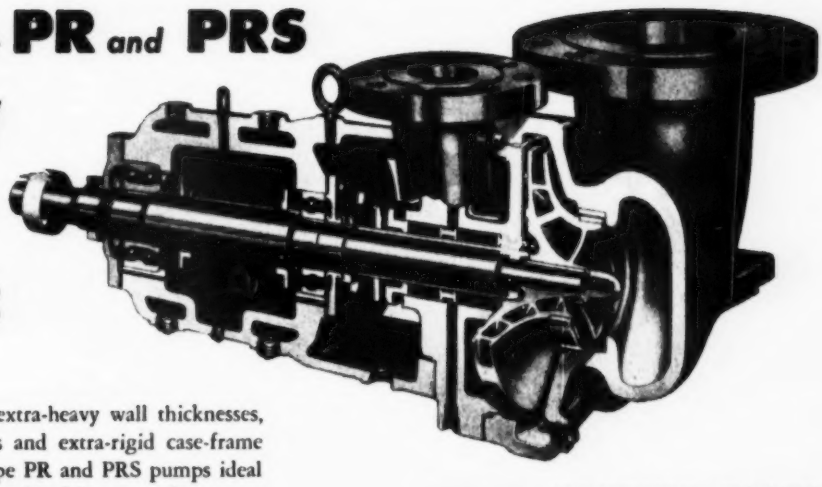
From among these stainless nickel alloyed steels, you can select exactly the right type for your specific needs. Leading steel companies produce austenitic chromium-nickel stainless steels in all commercial forms.

A list of sources of supply will be furnished on request.

SYMBOL OF INCO SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

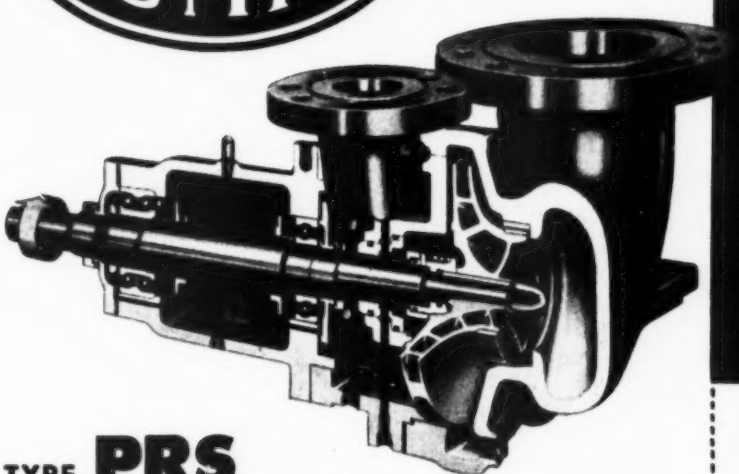
Peerless *type* PR *and* PRS REFINERY PROCESS PUMPS:



Maximum interchangeability, extra-heavy wall thicknesses, extra-low NPSH requirements and extra-rigid case-frame construction make Peerless Type PR and PRS pumps ideal for refinery process services. Furnished in a complete range of sizes, these Peerless pumps cover nearly all your pump needs. The option of adequate water-cooling jackets and water-cooled stuffing box or mechanical shaft seal design, plus heavy duty shaft with carefully balanced bearing design, are other features of this Peerless line of refinery process pumps. Many sizes are available from stock.

PEERLESS PUMPS

CAPACITIES: up to 1000 gpm
OPERATING HEADS: up to 675 feet
TEMPERATURES: Type PR (Packing gland construction) up to 850° F; Type PRS (Mechanical Shaft Seal construction) up to 250° F.
CASE PRESSURES: up to 600 psi



TYPE PRS
MECHANICAL SEAL CONSTRUCTION

TYPE PR *PACKING GLAND CONSTRUCTION*

APPLICATION:

Liquids handled: hot oil, hot water, propane, butane and all petroleum hydrocarbons, process liquors, Dowtherm, and numerous chemical solutions. Designed to operate with minimum available NPSH

TYPES:

Two basic pump types. Type PR is packing gland construction. Type PRS is mechanical shaft seal construction. Both types are available in end- or top-suction, top-discharge designs. Horizontal electric motor drive is standard, other types of drive available.

ADVANTAGES:

Center-Line-Mount design maintains alignment at any temperature. Heavy-duty construction throughout. Spacer type coupling permits inspection or repair without disturbing piping. Liquid end can be furnished in cast iron, bronze, carbon steel, stainless steel or other materials as required.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

Address inquiries to Factories at:
Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York; Indianapolis; Chicago; St. Louis; Atlanta; Dallas, Plainview and Lubbock, Texas; Fresno; Los Angeles; Phoenix; Albuquerque, N. M.

PEERLESS PUMPS fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send us copy of Peerless Type PR Pump Bulletin No. B-1605.

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

Pet. Ref.

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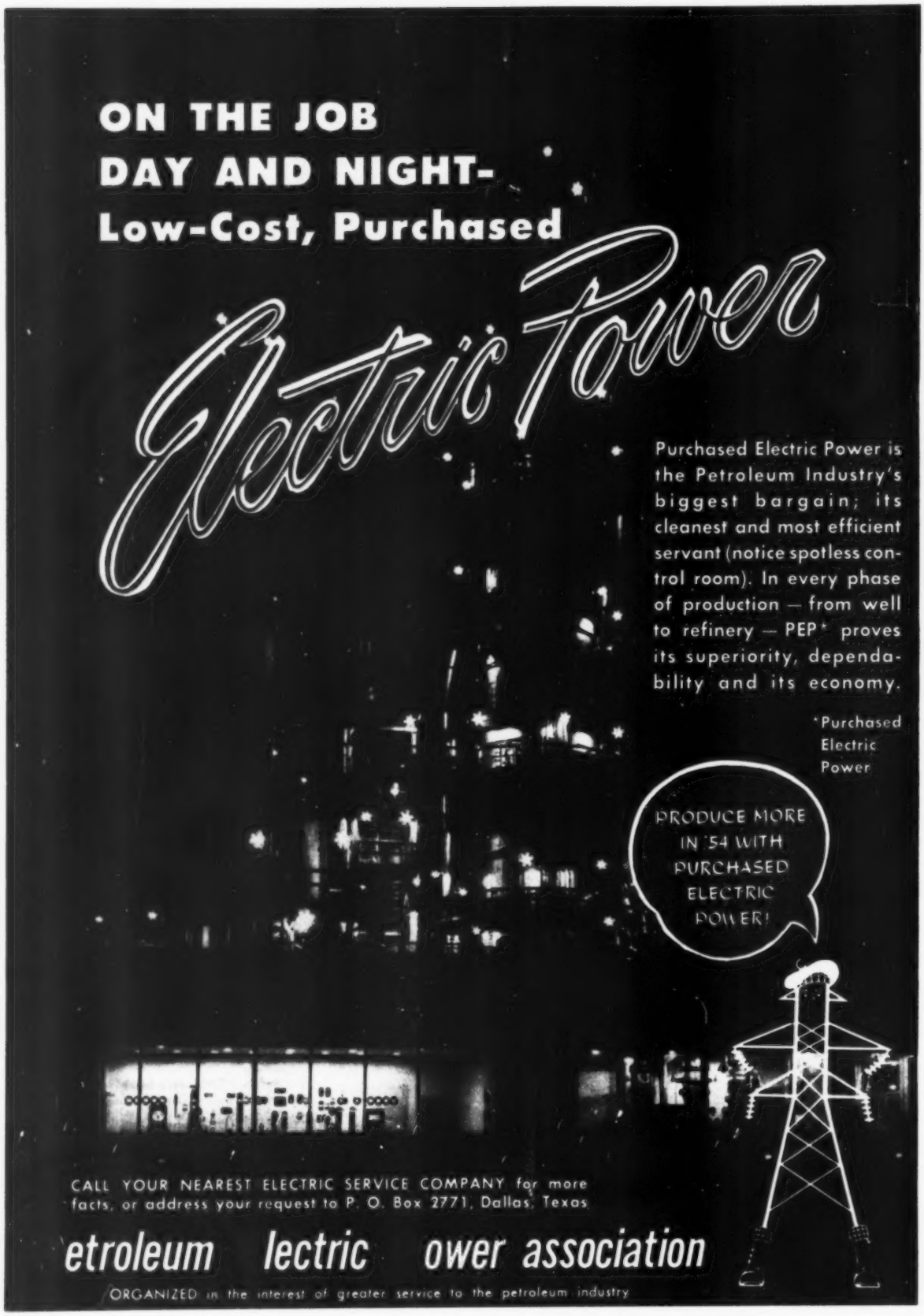
ON THE JOB
DAY AND NIGHT-
Low-Cost, Purchased
Electric Power
Purchased Electric Power is the Petroleum Industry's biggest bargain; its cleanest and most efficient servant (notice spotless control room). In every phase of production — from well to refinery — PEP* proves its superiority, dependability and its economy.
*Purchased Electric Power
PRODUCE MORE IN '54 WITH PURCHASED ELECTRIC POWER!
CALL YOUR NEAREST ELECTRIC SERVICE COMPANY for more facts, or address your request to P. O. Box 2771, Dallas, Texas
etroleum lectric ower association
ORGANIZED in the interest of greater service to the petroleum industry

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for LP Gas ODORIZATION

IT COSTS NO MORE TO HAVE THE BEST...

4847

When you order a drum of Natural Gas Odorizing Co., Inc., odorant, you are purchasing not only the best material available for the specific job, but you are also obtaining the services of an organization solely devoted to the business of gas odorization.

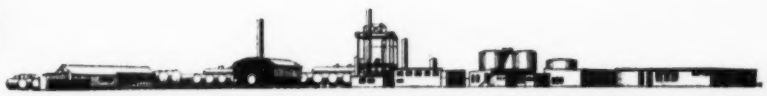
Prompt Service from our . . .

- EXPERT SPECIALLY TRAINED ENGINEERS
- COMPETENT OFFICE FORCE
- STRATEGICALLY LOCATED WAREHOUSES
- RELIABLE SHIPPING SERVICE

...AND FREQUENTLY IT COSTS LESS!

Don't Delay . . . phone, wire or write us today.

captan



NATURAL GAS ODORIZING CO., INC.

P. O. BOX 1645-A HOUSTON, TEXAS

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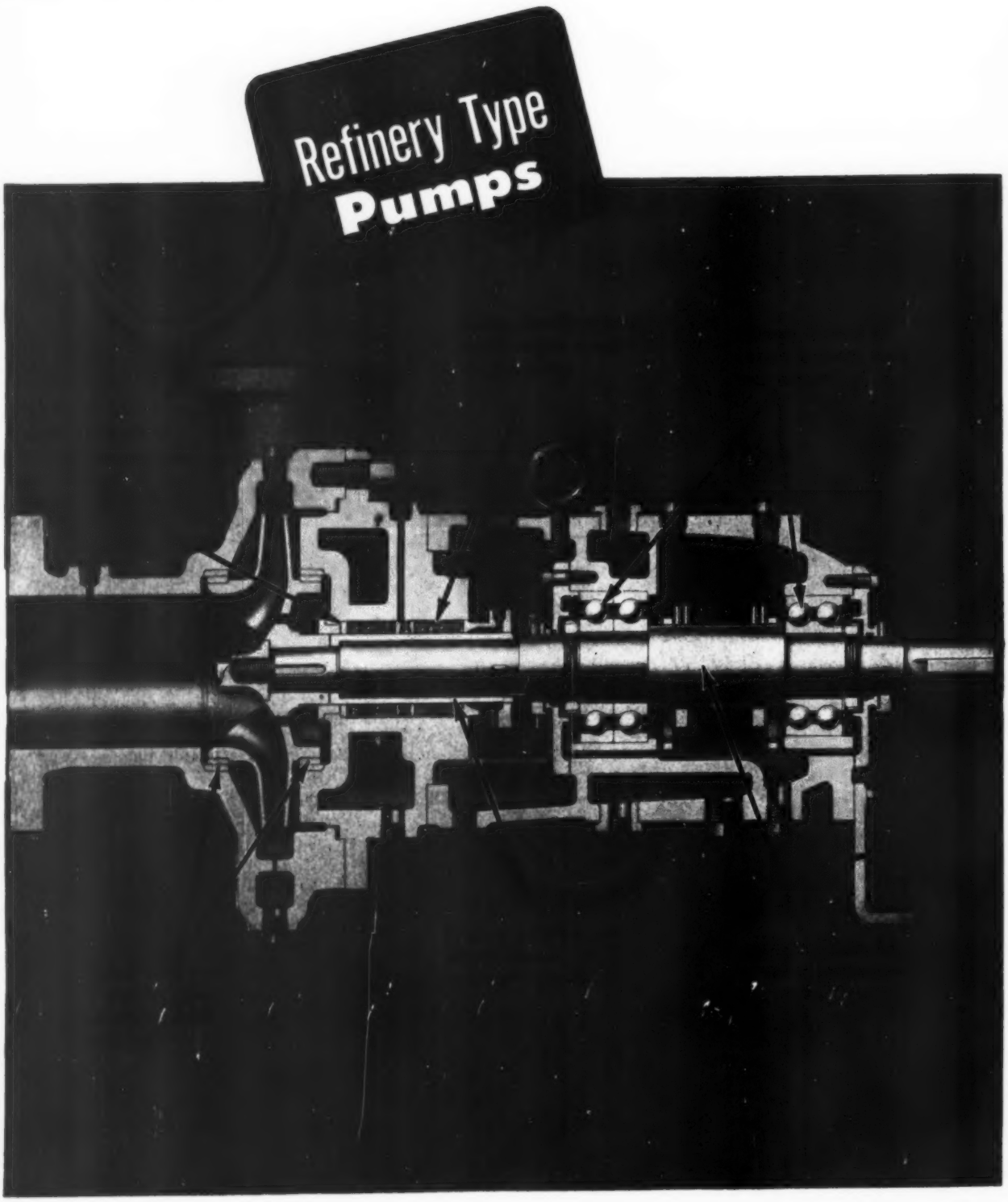
EXTRA heavy-duty construction



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gives you

service continuity

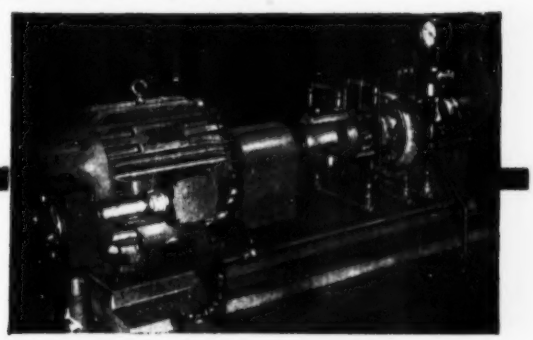
WHERE A STOPPAGE COSTS A FORTUNE, install Allis-Chalmers Refinery Pumps. These pumps have the stamina to keep going on the toughest applications for years without rest. Every construction detail, those shown here and many others, has been carefully engineered to provide ample reserves of strength and durability. Careful workmanship and expert application engineering make these pumps deliver all the reliability that is designed into them.

Wide Choice of Materials, Features

The Allis-Chalmers Refinery Pump can be fitted to suit your requirements exactly. Practically any material normally used in pumps may be specified. Stuffing box takes packing, mechanical seal or both. Cooling water or oil may be used in five separate places so you can select exactly the cooling arrangement for your particular needs. Suction may be at top or on end.

Get Complete Information and Engineering Help

Your nearby Allis-Chalmers representative will be glad to help you with your refinery pump problems. Or write for Bulletin 52B7775. Allis-Chalmers, Milwaukee 1, Wisconsin.



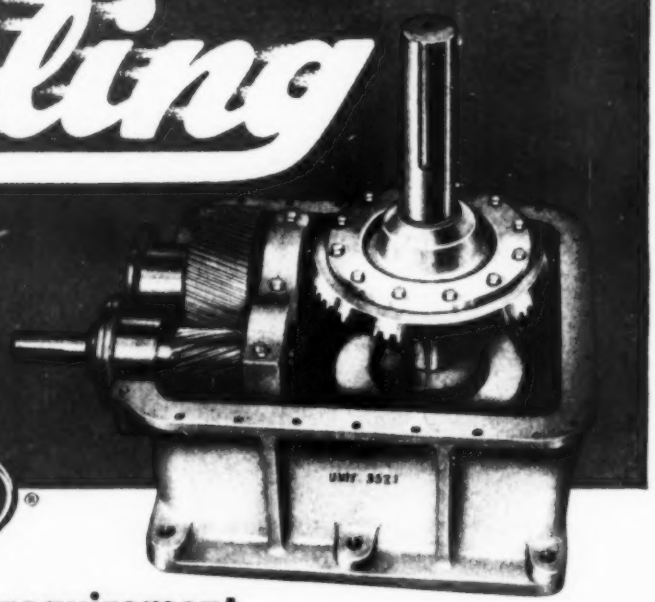
Save Engineering and Installation Time with an Allis-Chalmers Pump Package

Allis-Chalmers will supply a complete pumping unit — pump, motor and control — engineered to work together and with pump and motor mounted on a single base plate ready for installation. You save engineering time because you don't have to match components from different manufacturers. You save installation time because the unit comes to you already assembled. And, most important, you are sure that the components will work together to give you long life at low operating cost. The complete unit is covered by a single guarantee backed by Allis-Chalmers well-known customer satisfaction policy.

A-4333

ALLIS-CHALMERS

3 Cooling TOWER DRIVES by PHILLIE GEAR®



a type and size for every requirement

The growing use of larger fans in cooling tower service brought the need for a drive that would best meet heavier load conditions. Philadelphia, having long been a leading manufacturer of conventional worm gear cooling tower drives, thoroughly understood this problem and presents a complete line of right angle Speed Reducers . . . Worm Gear, Spiral Bevel, and Helical Spiral Bevel. All three types are specifically manufactured for cooling tower fan drives. Housings are made of high quality close-grained grey iron and are proportioned to withstand the severe stresses encountered during operation. All shafts mounted in anti-friction bearings to assure high efficiency, correct center distance and proper shaft alignment. Bearings provide generous thrust and radial capacity . . . all these features give long, quiet service life.

worm gear

HP range—3 thru 30 HP @ 1750 rpm input.

Ratio range—3⅝ to 83¼.

Efficiency—up to 95% depending on ratio.

Application—Best economy in range up to 25 HP. Quiet operation, suitable for input speeds up to 2000 rpm.

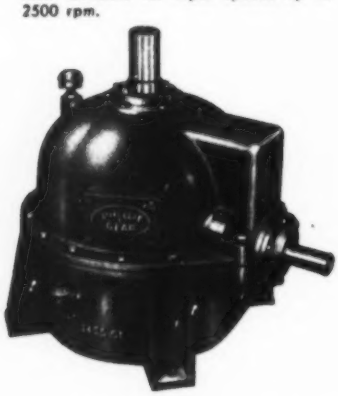
spiral bevel

HP range—15 thru 75 HP @ 1750 rpm input.

Ratio range—3½ to 9¼:1.

Efficiency—97-98%.

Application—Best economy above 15 HP. Advantages of high efficiency, small heat loss. Suitable for input speeds up to 2500 rpm.



helical spiral bevel

HP range—20 thru 115 HP @ 1750 rpm input.

Ratio range—6⅔ to 15:1.

Efficiency—95-96%.

Application—Best economy when used on drives greater than 25 HP and when required ratios exceed those possible with single reduction spiral bevel. This unit also best suited for turbine applications up to 4000 rpm input.

Write for our new catalog CT-53 illustrating all types of Cooling Tower gear drives and their applications.

PHILADELPHIA GEAR WORKS, INC.

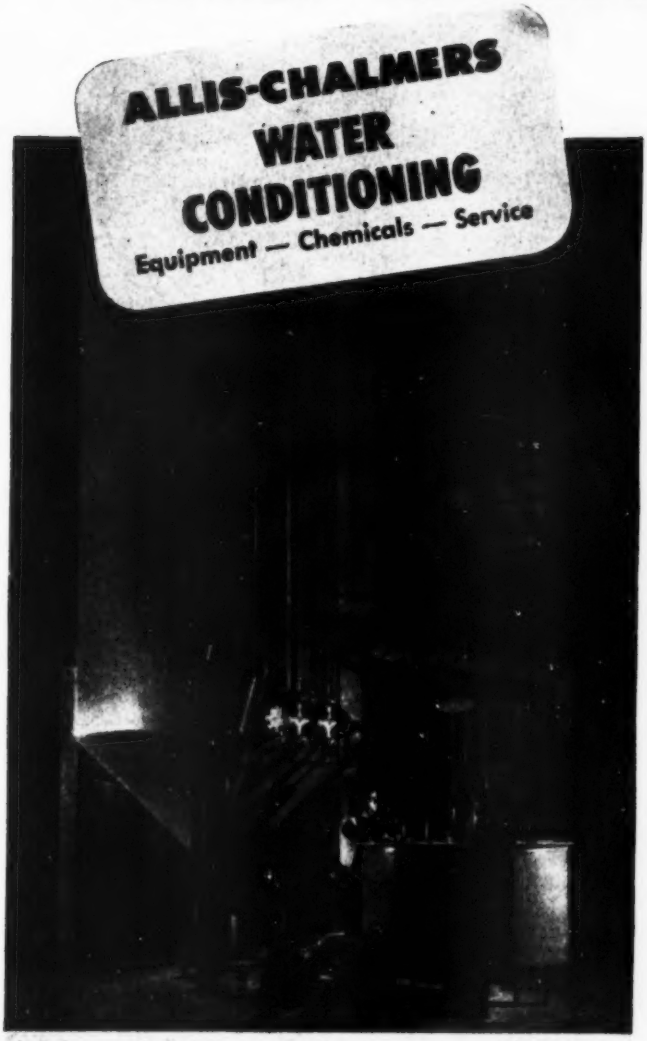
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears & Speed Reducers

LimiTorque Valve Controls

Gilbert Paper Co., Menasha, Wis.

Prevents SCALE and CORROSION



Equipment at Gilbert Paper Company includes hot process lime-soda softener and chemical feeder. For more information on this process, write for Bulletin 28B6611.

To prevent scale and corrosion in water used for steam generation, Gilbert Paper Company removes mineral constituents and dissolved gases by using Allis-Chalmers hot process lime-soda water conditioning. As a result, boiler outages and maintenance are greatly reduced. The process is the same as that used in many installations for process water.

What Hot Process Lime-Soda System Does

The complete installation heats water to the boiling point for removal of corrosive gases. Proportioning equipment introduces chemical reagents continuously and precisely into the water being treated. Precipitate induced by the thermo-chemical reaction is coagulated, settled, and separated from the water, which is then ready for use in steam generation. Apparatus includes a chemical solution tank, chemical proportioner and pump, reaction and sedimentation tank, pressure filters and accessories.

How You Can Solve Your Water Problems

If you have a water problem, you'll find Allis-Chalmers complete service a useful addition to your power or process water operations. Many years of experience plus a complete line of equipment and chemicals enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4190

ALLIS-CHALMERS

IN TIMES SQUARE OR TIMBUKTU WE ARE INTERESTED IN YOU... AND YOUR VACUUM PROBLEMS

GEORGE O. EDWARDS
BIRMINGHAM, ALA.

HANS W. FORSTER
FORSTER-JOHNSTON CO.
BUFFALO, N. Y.

ARTHUR W. JOHNSTON
FORSTER JOHNSTON CO.
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STANLEY ZAND
PAUL CHAPMAN & ASSOCIATES
CHATTANOOGA, TENN.

P. M. DEBEERS
P. M. DEBEERS & ASSOCIATES
CHICAGO, ILL.

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SAN FRANCISCO

J. J. VOLLMER
PROCESS ENGINEERING & EQUIPMENT CO.
ST. LOUIS, MO.

OSO TOWER
TOWER EQUIPMENT CO.
SEATTLE, WASH

DICK DONELSON
TOWER EQUIPMENT CO
SEATTLE, WASH

Representatives whose photographs were not available at press time:

A. L. RIDER
BOSTON, MASS

R. J. BELL
CLEVELAND, OHIO

GEORGE BELSO
PHILADELPHIA, PA

JOHN W. MCGREGOR
MCGREGOR ENGINEERING CO.
TULSA, OKLA.

Representatives whose photographs were not available at press time:

JAMES J. PERRY
PAUL CHAPMAN & ASSOCIATES
JOHNSTON CITY, TENN.

DUBOIS WEBB CO
DETROIT, MICH

OAKLEIGH W. ROBINSON
WASHINGTON, D. C.

During the 37 years our firm has been specializing in jet vacuum equipment, we have built up an exceptional organization of engineers who devote their full time to this important equipment. We have also acquired during this period a group of engineering representatives in twenty cities who handle our equipment in their respective territories. These men are all outstanding engineers. Each has average or better engineering education and many years of experience including detailed experience on our jets and condensers. Incidentally, these jets are used for vacuum cooling, jet mixers, jet heaters, jet absorbers, fume scrubbers, thermo-compressors, etc. Please contact any of them or us when you want to take advantage of our long experience in this highly specialized field.

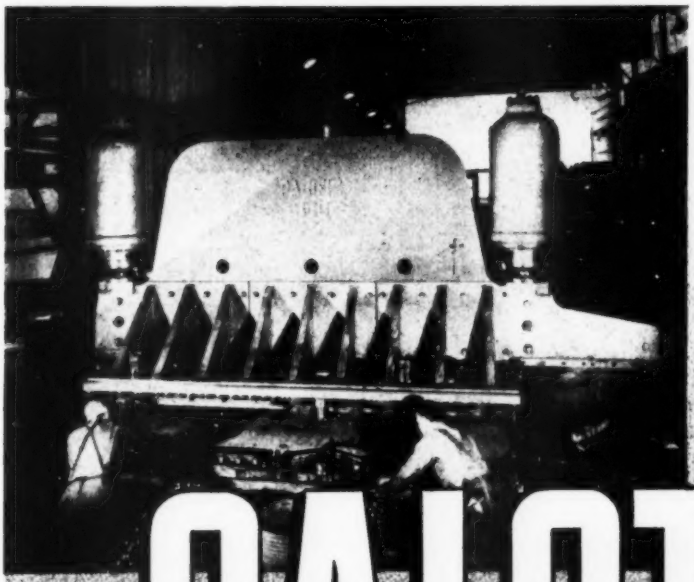
CROLL-REYNOLDS

Croll-Reynolds CO., INC.

Main Office: 751 Central Avenue, Westfield, N. J. New York Office: 17 John Street, N. Y. 38, N. Y.

CHILL VACTORS • STEAM JET EVACTORS • CONDENSING EQUIPMENT

CUSTOM ENGINEERED FABRICATION

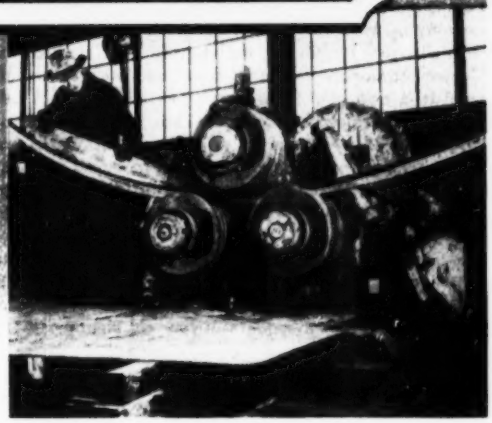


STEEL and ALLOY PLATE
STRUCTURAL • PIPE
for
Process, Oil, Gas
Atomic Energy and
Power Industries

CALSTEEL

ENGINEERED FABRICATION

CALSTEEL offers a completely versatile service in custom engineered fabrication, a significant service to meet the most exacting and extensive specifications. CALSTEEL fabricates steel and alloy plate into pipe, tanks, pressure vessels, and all types of special equipment... also structural fabrication to suit the particular needs of both the construction and industrial fields. Call on CALSTEEL for the answer to your problem!



CALIFORNIA STEEL PRODUCTS COMPANY

DIVISION OF AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES: RICHMOND, CALIFORNIA • PLANTS IN RICHMOND, CALIF. & NORTH TONAWANDA, N. Y.

District Offices: San Francisco • New York • Chicago • Philadelphia • Pittsburgh • Cleveland • Detroit • Buffalo

For more data on advertised products, use Readers' Service Cards, last page.

CONOMOTOR *Series* LB CONTROL VALVES

THESE LEADING COMPANIES have *MODERNIZED* with CONOMOTOR *Series* LB CONTROL VALVES

Progress cannot be denied! Naugatuck Chemical Division of U. S. Rubber Company has completely equipped a new plant with Conomotor Series LB Control Valves for temperature control on reactors. U. S. Steel is using a large quantity of these valves for various services in their new coal chemical facilities in the midwest. E. I. du Pont use Conomotor Control Valves for their complete valve equipment in a new pilot plant at their Eastern Regional Laboratories. Armstrong Cork Co. has standardized on Conomotor LB Valves for an extensive modernization program. These important decisions were based on thorough evaluation of design, performance and cost. When companies of this caliber approve and adopt a new advance in process control, you can rely on their judgment. These and other new installations are typical of the important part Conoflow final control elements play in the modern industrial evolution to automatic control. Whether you have a new plant or plan to modernize your old plant it will pay you to talk to Conoflow.

- Armstrong Cork Co.
- Bakelite Company
- Colgate-Palmolive Co.
- Curtiss-Wright Corp.
- E. I. du Pont de Nemours & Co., Inc.
- Emery Industries, Inc.
- General Electric Co.
- Heyden Chemical Corp.
- Naugatuck Chemical Division U. S. Rubber Co.
- Philadelphia Electric Co.
- Publicker Industries, Inc.
- Jos. Schlitz Brewing Co.
- Sharples Corp.
- The Sherwin-Williams Co.
- U. S. Steel Corp.
- Victor Chemical Works
- Westinghouse Electric Corp.

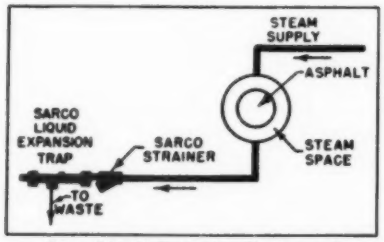
WRITE FOR CATALOG LB-1. "PORTENT OF THINGS TO COME"

CONOFLOW CORPORATION

FOREMOST MANUFACTURERS OF FINAL CONTROL ELEMENTS

2100 ARCH STREET, PHILADELPHIA 3, PA.

Misused steam plays havoc with production schedules and costs



Sarco Liquid Expansion Traps permit use of sensible heat of condensate.

How Seneca Petroleum Cut Monthly Steam Consumption 429,000 lbs.

Seneca Petroleum of Illinois pumps asphalt Flux-oil to its 14 steam-heated storage tanks via a steam-jacketed line from a nearby refinery.

The traps which were draining condensate on tanks and flow lines were doing an adequate job. However, since they were discharging at about steam temperature and the condensate was going to waste, Seneca's plant manager decided he could save additional steam by installing Sarco Liquid Expansion Traps.

These traps discharge at *adjustable temperatures below 212° F,* permit the use of the condensate's sensible heat. Although another 100,000 gallon tank was subsequently installed, Seneca was able to reduce monthly steam consumption from 2,429,000 lbs to 2,000,000 lbs.

This is but another example of savings effected by proper steam utilization.

Sarco Liquid Expansion Thermostatic Trap

Discharges condensate at pre-set temperatures below 212° F. Withstands waterhammer, pressure pulsations and superheat. Freeze-proof. *Write for Bulletin 260.*

Use Steam Right

1. To prevent production delays
2. To improve product quality
3. To maintain desired output
4. To reduce labor and steam costs

IN YOUR processing operations, are you up against troubles such as slow-ups, uneven or inadequate heating, poor temperature control—resulting in reduced output, lowered product quality and increased costs?

You may suspect that your equipment is at fault. But process heating headaches often are due to ineffective utilization of steam. The wrong type trap can cause condensate to waterlog equipment. Improper air-venting can reduce the rate of heat transfer by as much as 11%. Manual temperature control may prove erratic, affect product quality, increase production costs.

If your plant is suffering from any of these production handicaps, Sarco can help you. Sarco has a wealth of practical experience in the process industries to put to work for you. Plant after plant, with Sarco help, has licked these problems through simple, inexpensive changes. The results have been: increased output, improved product quality uniformly maintained, lower production costs.

Engineering Service: Our engineering service is yours for the asking. Call our local representative, or, write today for case histories describing how other plants in your field have solved similar problems through the proper application of steam traps and inexpensive temperature controls. Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

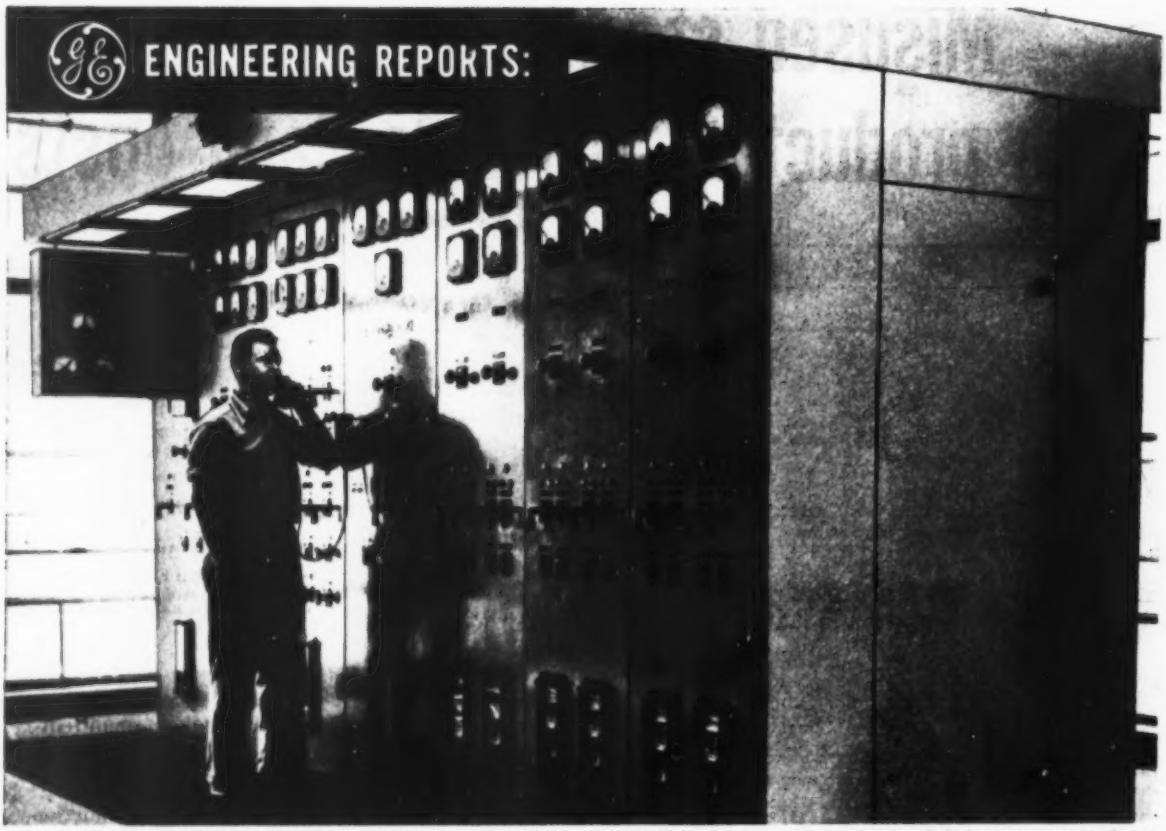
SARCO

improves product quality and output

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS

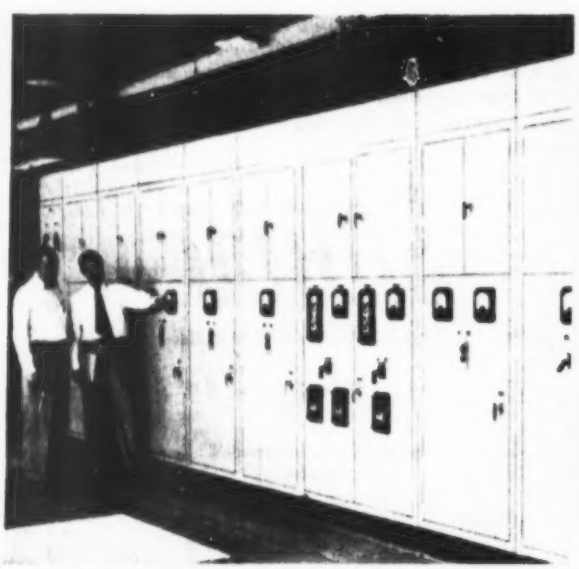
Thermostatic Steam Traps | Float-Thermostatic Steam Traps | Thermodynamic Steam Traps | Camlift Bucket Steam Traps | Liquid Expansion Steam Traps | Strainers | Electric Temperature Controllers | Water Blenders | Self-Operated Temperature Controllers

For more data on advertised products, use Readers' Service Cards, last page.

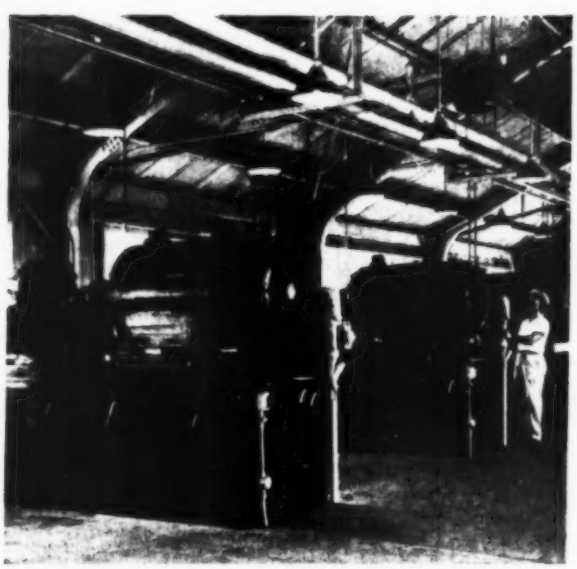


COMPACT, CENTRALIZED CONTROL PANEL handles high-voltage distribution economically for the entire Eagle Point Refinery operation. Incoming power from both plant generators is distributed to transformer banks, G-E limitamp control and switchgear. Interlocks assure safer operation, proper sequence. All enclosures are metal-clad for maximum protection.

G-E equipment helps Eagle Point



SIMPLE, FLEXIBLE DRIVE CONTROL for power station auxiliaries is provided by this G-E Limitamp panel. It protects motors for service pumps, raw water pumps, air supply apparatus.



FOR GREATER CONTINUOUS PROCESSING SAFETY, G-E motors at Eagle Point are totally enclosed, explosion-proof. Here, motors ranging from 200 to 400 hp drive transfer oil pumps.

ROUND-THE-CLOCK PRODUCTION at Eagle Point is aided by dependable G-E outdoor lighting. This modern plant-wide lighting system allows equipment to be moved quickly, safely. Critical operating areas are brightly lighted to step up efficiency of nighttime operating and maintenance work. Result: maximum output, night and day.

boost output 50% over rated capacity

20,000 barrels a day increase at Texaco's Westville, N.J. refinery aided by co-ordinated General Electric equipment

The Texas Company's Eagle Point Refinery in Westville, N. J. recently hit a production high when it boosted its output 50 per cent over rated capacity. General Electric equipment helped in this production increase—approximately 20,000 barrels of crude throughput a day.

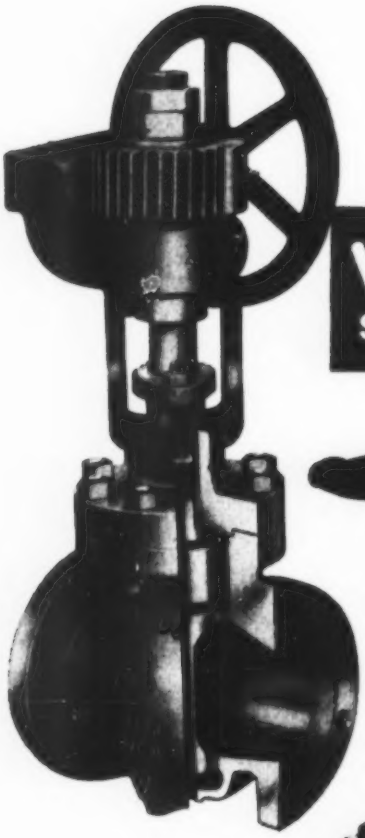
Eagle Point is another of this country's top refineries to use co-ordinated G-E equipment and engineering services. G-E engineers, specializing in refinery applications, helped the Texas Company plan the electrical system, which includes provisions for future plant expansion. High-voltage distribution is one of the system's key features power is transmitted to substations at 13,800 volts, reducing losses and improving voltage regulation.

If you are planning to build, expand, or modernize, let a team of G-E engineers help you design an electrical system for top production and flexibility. Contact your nearby G-E Apparatus Sales Office early during the preliminary planning. General Electric Company, Schenectady 5, N. Y. 661-43

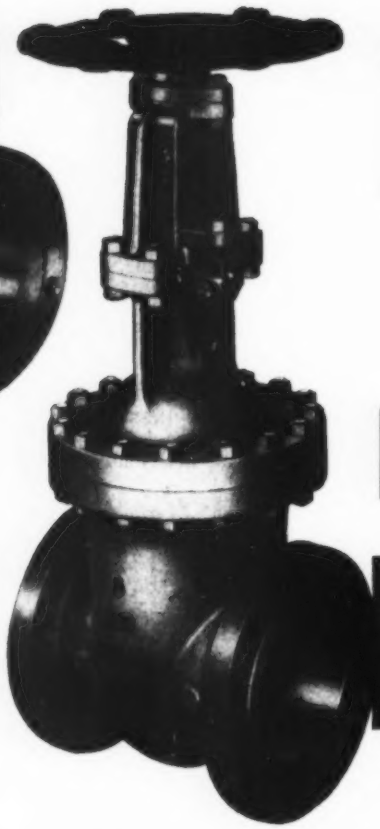
Engineered Electrical Systems for Petroleum Refineries

GENERAL ELECTRIC

For more data on advertised products, use Readers' Service Cards, last page.



WEDGEPLUG
STEEL DRY PLUG VALVES



Twins in good performance

• The "know how" developed by the Stockham Organization during a half-century of manufacture assures the good performance of WEDGEPLUG and STOCKHAM VALVES.

STOCKHAM
CAST STEEL GATE VALVES

WEDGEPLUG VALVE COMPANY, INC.
NEW ORLEANS 15, LA.

An Affiliate of

STOCKHAM VALVES & FITTINGS
GENERAL OFFICES AND PLANT • BIRMINGHAM 2, ALA.

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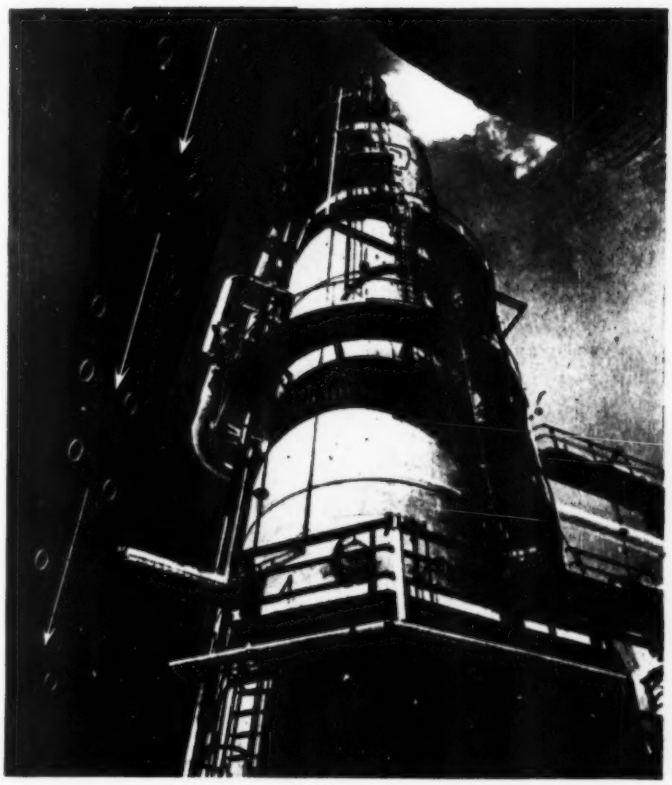
STEEL DRY PLUG VALVES • CAST STEEL GATE VALVES • BRONZE VALVES
IRON BODY VALVES • PIPE FITTINGS

Write for **STOCKHAM** *and* **WEDGEPLUG** *Catalogs*

DISTRIBUTED THROUGH WHOLESALERS

NEUTRALIZE OIL ACIDS WITH

LOW-COST *Anhydrous Ammonia*



Get dual protection from acid:—

- neutralize unwanted acid constituents in oil
- protect valuable, costly equipment and storage tanks from corrosive acid

One pound of Anhydrous Ammonia will render harmless the same quantity of acid as several pounds of other neutralizers—yet it is one of the lowest cost neutralizing agents delivered to the refinery.

Here's how our Anhydrous Ammonia saves equipment: Easily vaporized, the ammonia is introduced into the gas stream, neutralizing corrosive acids as soon as they form. Because it is highly soluble and has a high rate of diffusion in oil, it goes to work without forming water or undesirable emulsions. Once neutralized, unwanted products are easily eliminated from the oil while excess ammonia is removed by blowing the oil with air.

Simplicity, low cost and high protection make the Anhydrous Ammonia system a highly preferred way to eliminate harmful acids. Find out how you can enjoy these advantages. Use the convenient coupon.

Shipping: Cylinder Ammonia—fast delivery from coast-to-coast chain of distribution points. 150-, 100- and 50-lb. cylinders.

In Bulk—from Hopewell, Va., Omaha, Nebr., or South Point, Ohio in 10,000-gallon tank cars.

Order a trial shipment of this exceptionally pure Anhydrous Ammonia *today!*

First In Ammonia Since 1890

NITROGEN DIVISION

ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Ammonia • Sodium Nitrate • Urea • Ethylene Oxide
Ethylene Glycol • Diethylene Glycol
Triethylene Glycol • Methanol • Formaldehyde
Nitrogen Tetroxide • U.F. Concentrate 85
Nitrogen Solutions • Fertilizers & Feed Supplements

NITROGEN DIVISION ALLIED CHEMICAL

VALUABLE HELP—SEND TODAY!

NITROGEN DIVISION, Allied Chemical & Dye Corporation
40 Rector St., New York 6, N. Y.

☐ Have a technical representative call on me. No obligation!
☐ Send me a copy of the "Guide for the use of Barrett® Brand Anhydrous Ammonia in Cylinders."

Name_____

Title_____

Company_____

Address_____

City_____ Zone___ State_____ PR-4

A Better America Through Chemical Progress • CHEMICAL PROGRESS WEEK • May 17 to 22, 1954

For more data on advertised products, use Readers' Service Cards, last page.

When you buy welding elbows . . .

Why take less when you can get more?

. . . (and at the same price)

ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ THEY COST NO MORE THAN OTHER ELBOWS.

As shown in the illustration above, Midwest "Long Tangent" welding Elbows have straight ends equal to ¼ of the nominal fitting diameter (a 12" elbow has tangents 3" long). For the reasons listed at the left, substantial savings are made on many piping systems by using Midwest "Long Tangent" Elbows. For more information about them, write for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and Boston

Sales Offices:

New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

6722

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

How not to get a bang out of the oil business!

What is it that flows like a river, is invisible, drops noiselessly to the ground, and in an instant could blow a service station right out of this world — or, if properly handled, will transport you anywhere in the United States and home again?

You know the answer. It's gasoline vapor!

Do all your employees know the answer? Do all your service-station people know how to handle gasoline safely? Will all the people your company is going to hire in the next month learn how? It's pretty important that they do.

Perhaps we can help you complete this important part of their education. During the war Ethyl developed a demonstration to teach Air Force personnel the why's and wherefore's of handling gasoline safely. The show proved so h'lp-

(Continued on next page)

Printed in U.S.A.

How not to get a bang out of the oil business!

(Continued from preceding page)

ful that many of our customers asked us to present it to their own people.

This we did. But soon we could not fill all the requests. So we put the Ethyl "Fire Power" demonstration on film and made prints generally available. We published the story in vivid comic books, and offered them in quantity to any refiner.

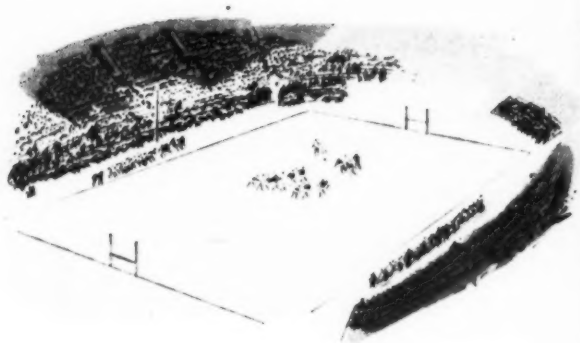
To give you some idea of how useful this film has been to the industry, in the last 3 years more than 133,000 people have seen it. And we've distributed several million copies of the "Fire Power" booklet.

We're particularly proud of the Ethyl "Fire Power" program because of the part it plays in helping our customers keep the oil industry one of America's safest places to work.

ETHYL CORPORATION
NEW YORK 17, NEW YORK

WORTH NOTING

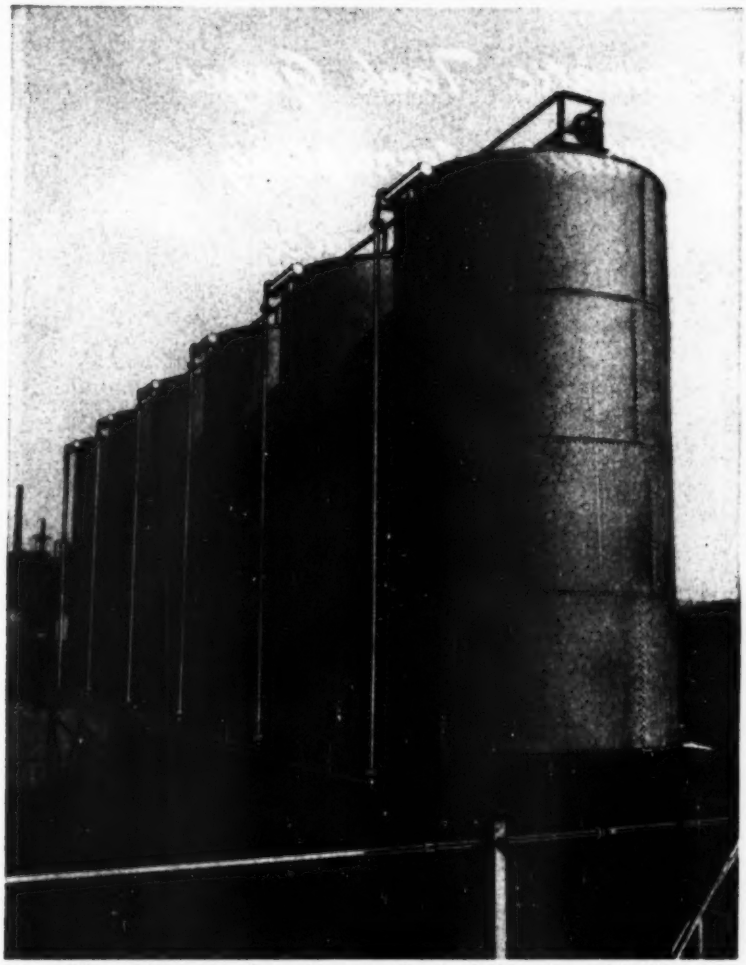
Desert temperatures are maintained year-in, year-out in a room at the Ethyl Research Laboratories in Detroit as part of a continuous study of gasoline stability during storage.



The official American football field is 100 yards long. If all the sodium cells at Ethyl's Baton Rouge plant were lined up, they would reach the length of five football fields. This is the largest sodium plant in the world!

The work of Ethyl's automotive engineers in the field is backed up by the experience of more than 100,000,000 research miles rolled up during road-test programs.

Ethyl Service is backed by 31 years of antiknock experience



Millions of Gallons of Gasoline are here protected against fire by a Rockwood Double-Barrelled FOAM Chamber.

Jet action for a fire

The cylindrical objects at the top of the gas tanks in the picture above are Rockwood Double-Barrelled FOAM Maker Chambers — protecting millions of gallons of gasoline.

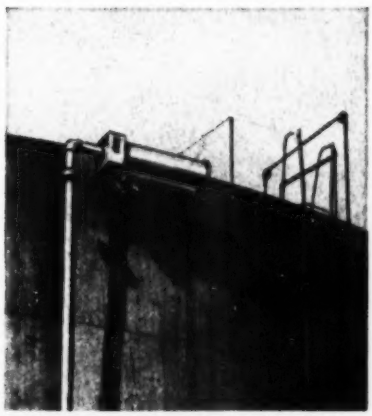
Should fire occur, the FOAM-Making Chambers would quickly control it, thus preventing any rupture of the tanks and the resultant spill fire. Such a fire could endanger the industrial area along the river 25 yards away and the entire river traffic, much of which is strategic material, hauled by river boats.

Due to a special jet action, the manually controlled Rockwood Double-Barrelled FOAM Maker Chamber puts a smothering FOAM blanket *swiftly* over flames, controlling and extinguishing the fire. Internal impinging jets discharge into two concentric barrels, one within the other, dynamically mixing air, water and FOAM liquid into a finer bubble structure than ordinarily possible. This construction is a patented one and typical of the many ways in which Rockwood engineers water to cut fire losses.

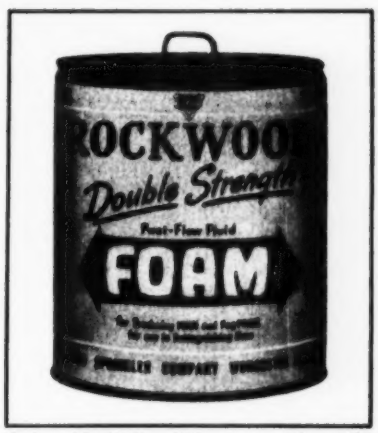
ROCKWOOD SPRINKLER COMPANY

ROCKWOOD *Engineers Water . . . to Cut Fire Losses*

How Rockwood Engineers Water to Cut Fire Losses



The Rockwood Double-Barrelled Foam Maker Chamber has a patented, compact design that eliminates supporting brackets, makes it easy to install. Also easy to inspect from top of tank. Wide range of sizes.



Rockwood Double Strength Foam puts out flammable liquid fires quicker, at lower cost. Three parts FOAM and 97 parts water create a heat-resistant blanket. Double strength FOAM flows freely at −15°F.

SEND FOR THIS INFORMATIVE BOOKLET

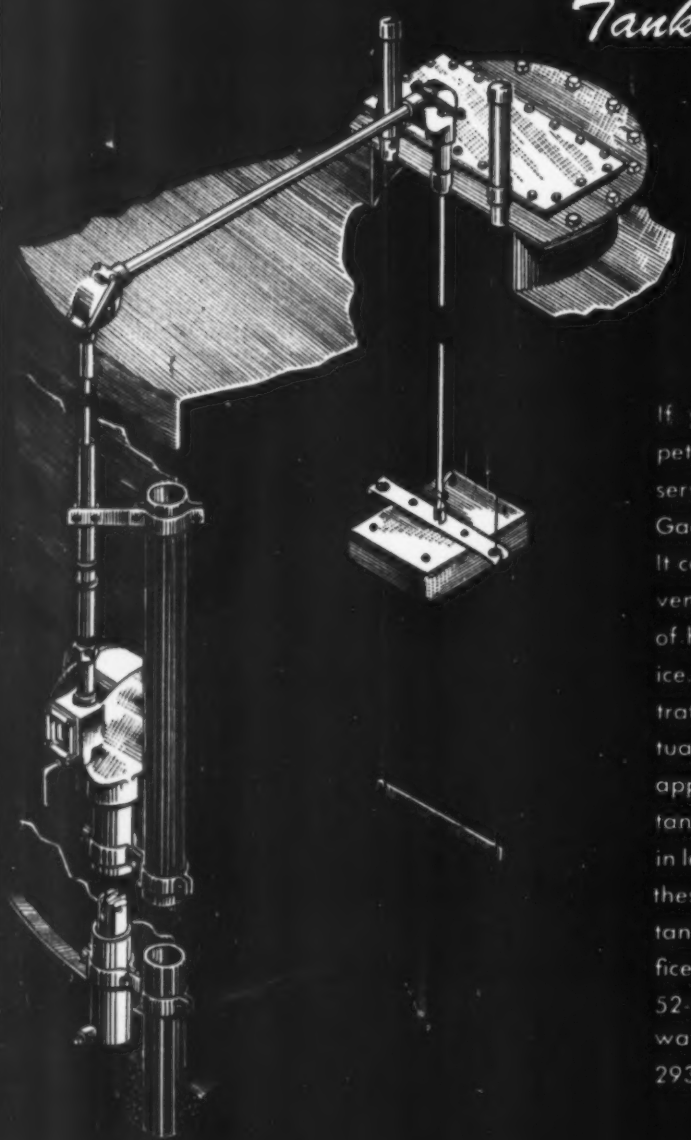
ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
102 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire fighting products.

Name.....
Title.....
Company.....
Street.....
City.....
Zone..... State.....

For more data on advertised products, use Readers' Service Cards, last page.

Install S&J Automatic Tank Gages without interrupting Tank Service



If you want to equip some of your petroleum storage tanks presently in service with S. & J. Automatic Tank Gages, there is no time like the present. It can be done at any time that is convenient to you, without the necessity of having to take the tank out of service. The S. & J. Automatic Gage illustrated here, is a high quality, float actuated gage designed for immediate application to five different types of tank construction. If you are interested in learning just how simple and quickly these gages can be installed on your tanks, write to any of the branch offices listed below for a copy of Bulletin 52-D which illustrates the five different ways of installing Gage Model ST-2935-S.

Shand and Jurs Co.
BERKELEY 10, CALIFORNIA

NEW YORK
342 Madison Ave

HOUSTON
M & M Bldg

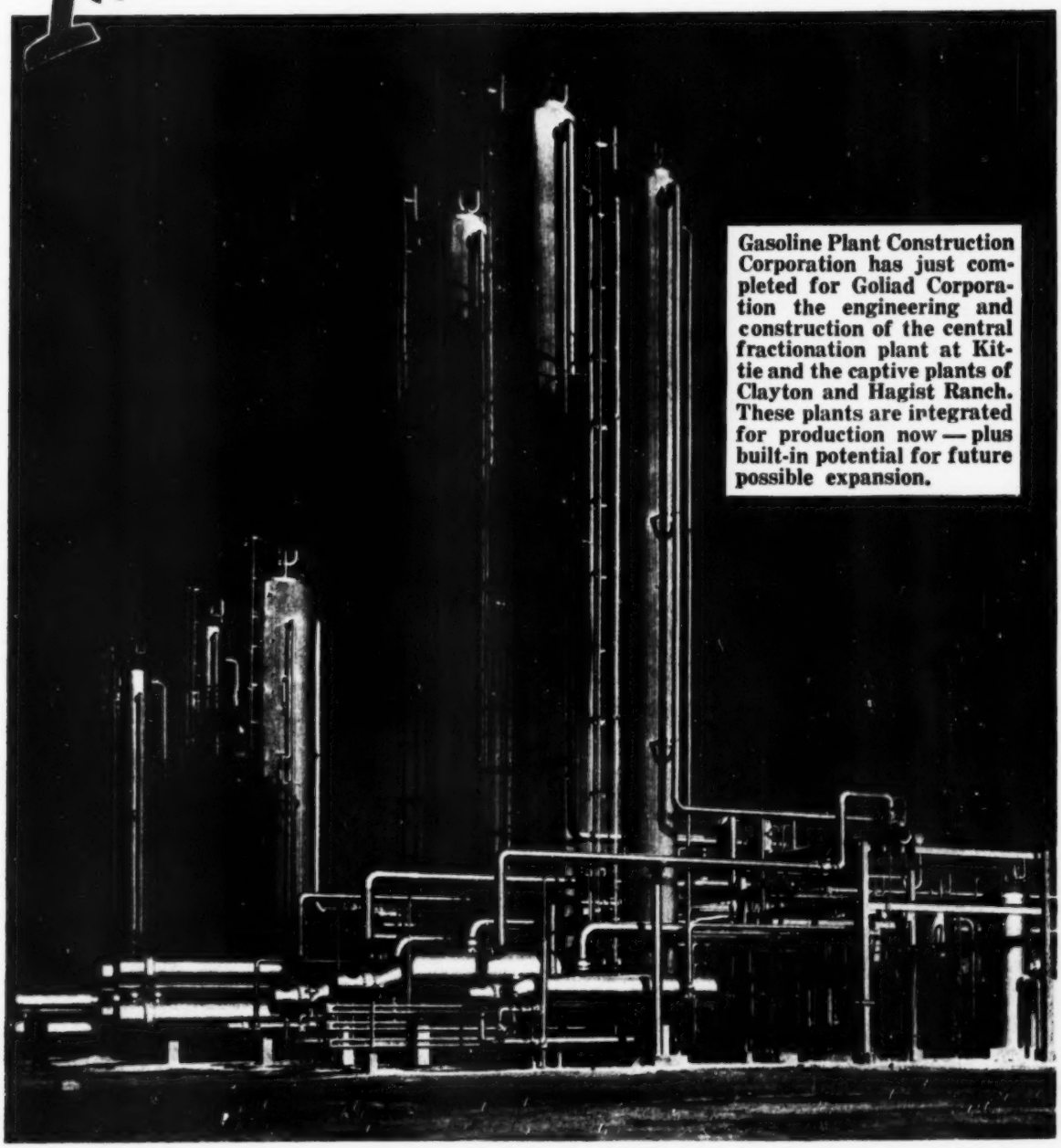
TULSA
Thompson Bldg

CHICAGO
10409 S. Western Ave

LOS ANGELES
714 W. Olympic Blvd

REPRESENTATIVES:
SEATTLE: Nelson Supply Company, 3300 Western Avenue
MONTREAL: Lytle Engineering Specialties, Ltd., 360 Notre Dame St. W.
TORONTO: Lytle Engineering Specialties, Ltd., 85 Richmond St. W.
VANCOUVER: P. D. McLaren & Son, Ltd., 3277 Main Street
CARACAS: Sinclair Spence, C.A., Edificio Galipan
ENGLAND: Whessoe, Ltd., Sales: 25 Victoria St., London, S.W. 1
Whessoe, Ltd., Works: Darlington, County Durham

INTEGRATION Along the Wilcox Trend



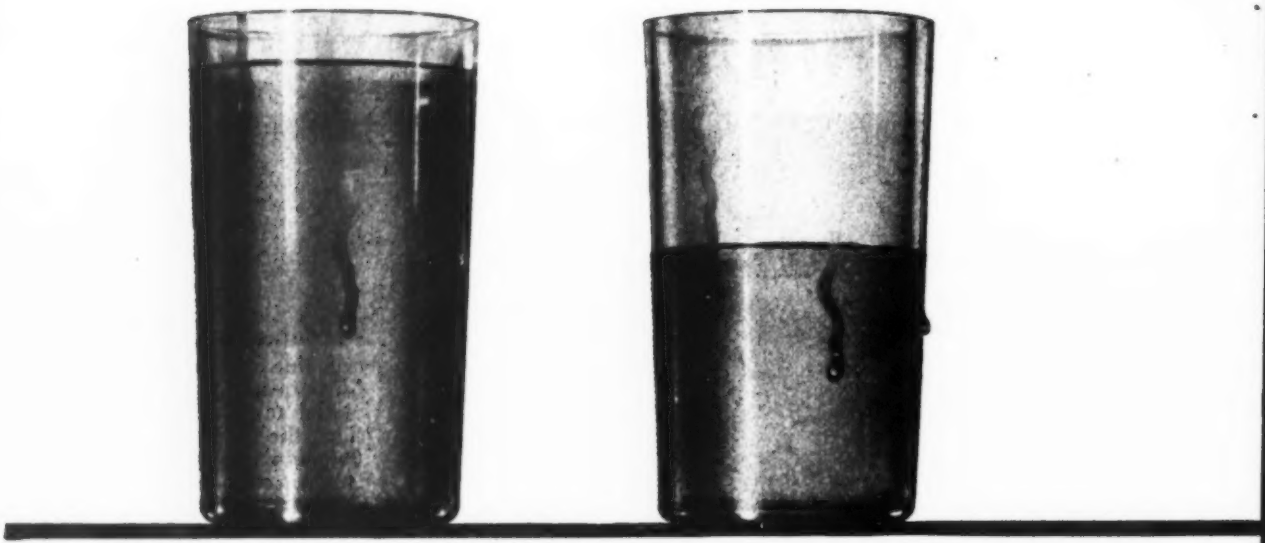
Gasoline Plant Construction Corporation has just completed for Goliad Corporation the engineering and construction of the central fractionation plant at Kittie and the captive plants of Clayton and Hagist Ranch. These plants are integrated for production now — plus built-in potential for future possible expansion.

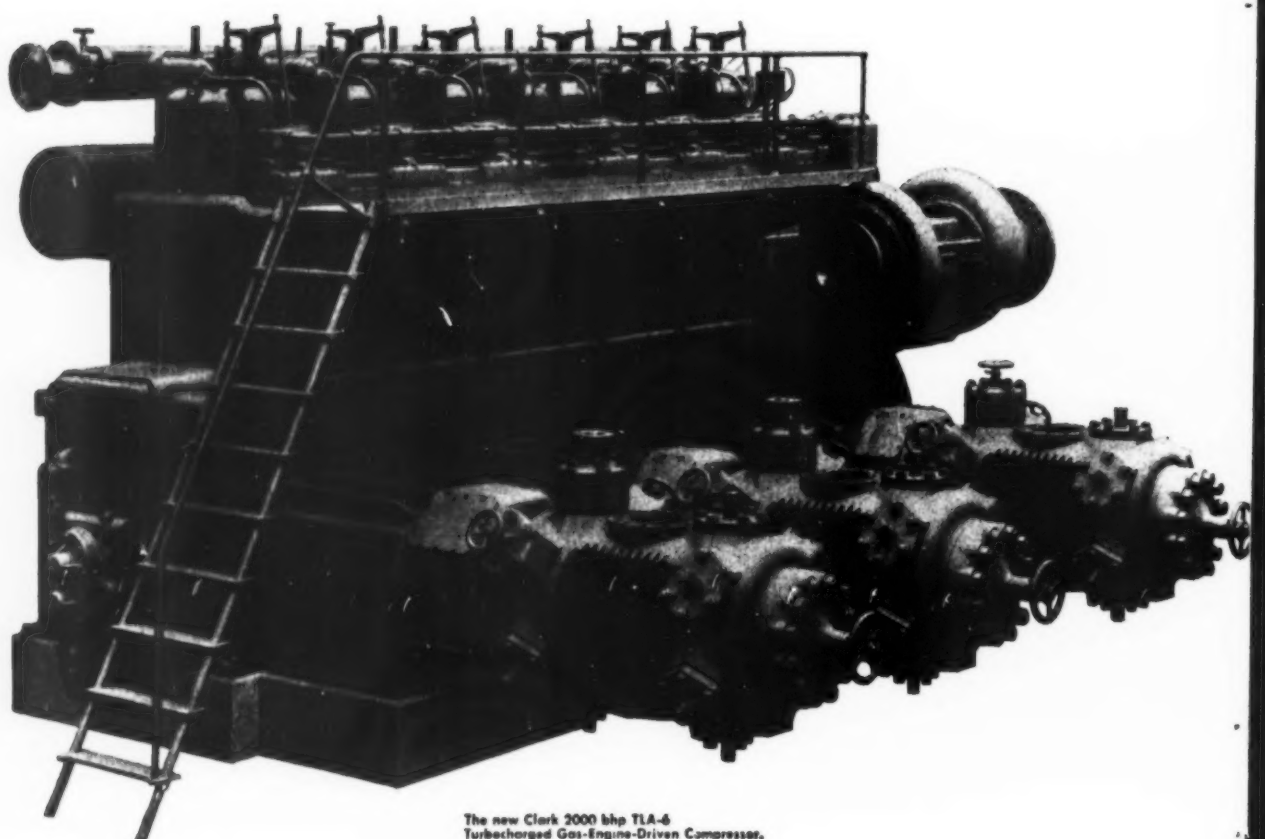
ENGINEERS • DESIGNERS • CONSTRUCTORS

GASOLINE PLANT CONSTRUCTION CORP.

NIELS ESPERSON BLDG., HOUSTON WILSON TOWER, CORPUS CHRISTI

For more data on advertised products, use Readers' Service Cards, last page.





The new Clark 2000 bhp TLA-6
Turbocharged Gas-Engine-Driven Compressor.

40% less water!

for cooling Clark Turbocharged Compressors

40% reduction in cooling water rates over comparable non-turbocharged compressors — that's what you save with Clark 2-Cycle Turbocharged Compressors. It's not hard to realize, of course, what big savings this will mean in your installation and operating costs.

How is this tremendous reduction in cooling water requirements made possible? Because these new Clark Compressors operate at higher thermal efficiency, much of the heat which was formerly rejected to the cooling water is now converted to useful work. Translate this into direct benefits, such as smaller cooling towers, fewer wells, smaller pipes and pumps, less water treating materials — and you can easily figure your own savings in installation and operating costs.

Add these savings to those that come from a 12½% reduction in fuel consumption, a 25% to 30% reduction in foundation and building costs — plus many other highly important features — and you'll quickly conclude that this is the most economical compressor to install and to operate.

Simple and dependable, like all Clark 2-Cycle "Angle" Compressors, the Turbocharged Models TRA and TLA are available in sizes ranging from 825 to 3300 bhp.

For complete details, call your nearest Clark representative or write for Bulletin 130.

CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

CLARK *Compressors*

Clark sets the pace in compressor progress

For more data on advertised products, use Readers' Service Cards, last page.

TRET-O-LITE

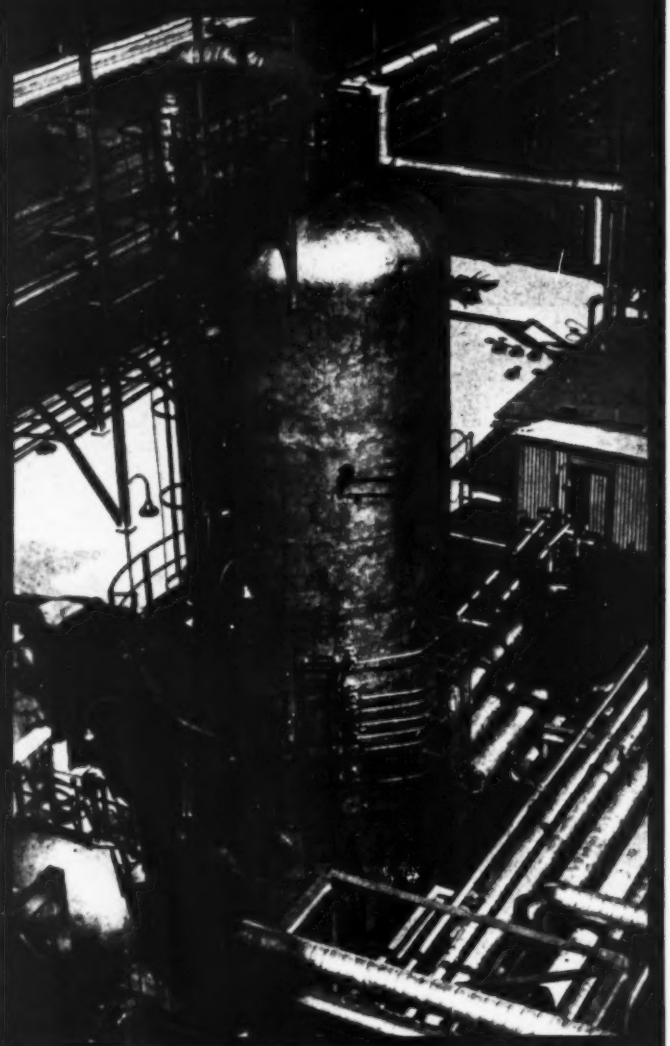
YOUR BEST BUY IN

DESALTING

Here are 5 reasons why

1. **LOWEST PLANT COST**
2. **LOWEST OPERATING COSTS**
3. **SIMPLICITY**
4. **EASE OF OPERATION**
5. **MAXIMUM EFFICIENCY**

Your Tretolite desalting engineer will gladly provide facts and figures to substantiate these statements. Why not get in touch with him?



TRETOLITE COMPANY

Chemicals and Services for the Petroleum Industry

DESALTING • CORROSION PREVENTING • SCALE PREVENTING
DEMULSIFYING • WATER DE-OILING • PARAFFIN REMOVING

TD 54-21

SAVED: $120,000 on refinery fabrication with...

KEY-KAST

ALLOY STEEL WELDING FITTINGS

Substantial Savings for Leading Refinery
PLUS These Other Outstanding KEY-KAST Benefits

1. Delivery of fittings was on *schedule* with the pipe.
2. Quality of the fittings was consistent throughout, with not one rejection.
3. Although KEY-KAST fittings were *not* ordered to radiographic quality—all weld ends were gamma rayed and KEY-KAST fittings showed up better than class 2 per ASTM E-71.

GIVE YOUR PIPING SYSTEM THE ADVANTAGES OF KEY-KAST ALLOY STEEL WELDING FITTINGS

- Greater wall thickness throughout with extra thickness in critical areas.
- Lower unit cost.
- Meet A.S.M.E., A.S.T.M., A.S.A. Codes.
- Rigidly tested and inspected to meet high standards of quality.

IN ALL SHAPES, SIZES, SCHEDULES IN LOW AND INTERMEDIATE ALLOYS AND VARIOUS STAINLESS STEELS

Write for information and prices

Since 1916 . . . manufacturers and developers of products for high temperatures and pressures

key company

Box 494-E, EAST ST. LOUIS, ILLINOIS

DISTRICT OFFICES: NEW YORK • CLEVELAND
CHICAGO • TULSA • HOUSTON • LOS ANGELES

More Uniform Filtration and Diffusion with

SMOKE BLOWN THROUGH a Norton ALUNDUM seamless tube escapes evenly thoughout the tube's entire area. Such a tube gives most efficient filtration and ease of cleaning by back washing. When selecting tubes for your specific application be sure they embody this important feature.

ENGINEERED ℞ PRESCRIBED

NORTON POROUS MEDIUMS

Many filtering and diffusion processes throughout industry are efficiently accomplished with Norton ALUNDUM* Porous Mediums. These include filtration, filtration with filter aids, under drain systems, and gas diffusion applications.

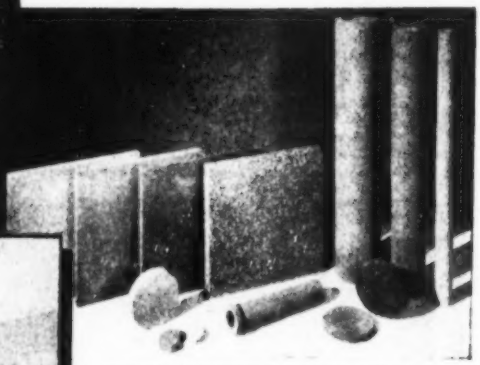
Uniformity of flow, ease of installation and cleaning, and resistance to attack of most industrial chemicals make them particularly suitable for chemical processing.

Even distribution of like pores throughout every plate and seamless tube made by the Norton Controlled Structure Process assure uniform flow and constant flow rate.

ALUNDUM porous plates and seamless tubes are available in a variety of sizes and permeability ratings. Chances are you can handle your filtering and diffusing processes more economically with these products.

For further information

Contact your Norton representative or write for free booklet Form 140, to NORTON COMPANY, 463 New Bond Street, Worcester 6, Massachusetts. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.



NORTON ALUNDUM POROUS MEDIUMS are available as tubes, plates and discs in a wide range of sizes and pore diameters.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

POROUS MEDIUMS

ENGINEERED ℞ PRESCRIBED

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

Think of Tomorrow's Water Needs Today

Growth—production—expansion—apply those words to city, farm or factory and you find that accomplishment is tightly tied to water. And yet planning for tomorrow's water needs is too frequently postponed until tomorrow becomes—today.

Layne ground water development service is unique in the dictionary sense of the word. A service that may—and frequently does—start with exploration. A service that has no ending—a continuing service—for Layne's responsibility to a Layne project or installation lasts as long as the need for water exists.

That service is available to everyone. It costs no more—and usually a lot less—because from initial surveys and test drilling to completed installation Layne brings to any job of any size the pooled knowledge of nearly three quarters of a century.

The Layne organization is glad to be of service on any immediate phase of ground water development—maintenance or modernization of existing equipment—new pump equipment—drilling—exploration or water treatment.

But also it is wisdom to use that service today in forecasting the needs of tomorrow. Why not permit Layne to make—with your assistance—the plans that will provide a dependable adequate water supply for the years that lie ahead.

LAYNE & BOWLER, INC.
Memphis 8, Tennessee

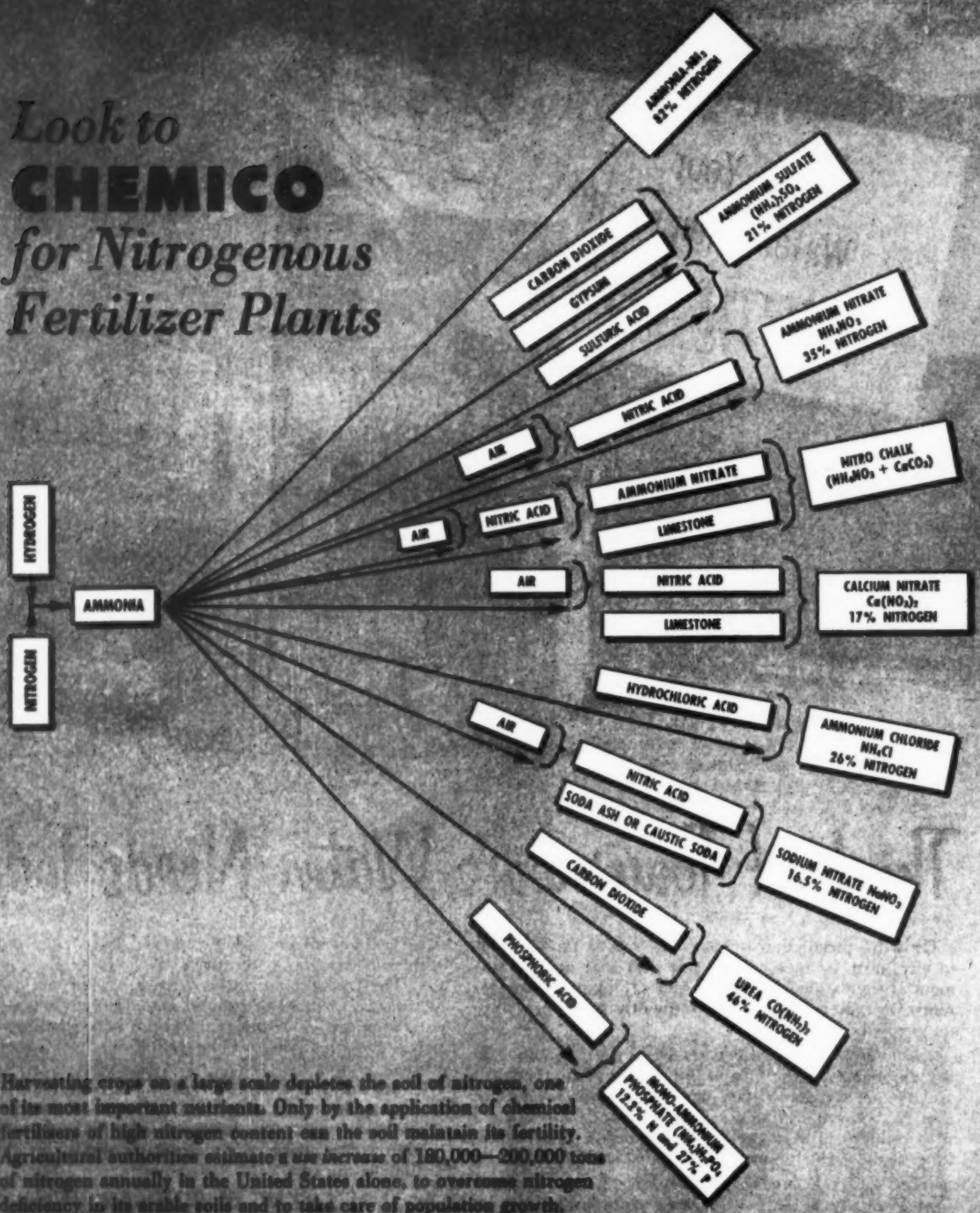
Layne Associate Companies Throughout the World

Layne

■ Agriculturists will be interested in a free booklet—"Layne for Profitable Irrigation." Sent upon request.

Water Wells • Vertical Turbine Pumps • Water Treatment

Look to **CHEMICO** *for Nitrogenous Fertilizer Plants*



Harvesting crops on a large scale depletes the soil of nitrogen, one of its most important nutrients. Only by the application of chemical fertilizers of high nitrogen content can the soil maintain its fertility. Agricultural authorities estimate a *use increase* of 180,000—200,000 tons of nitrogen annually in the United States alone, to overcome nitrogen deficiency in its arable soils and to take care of population growth.

The Chemico organization is specially qualified to design and construct plants for the production of ammonia and nitrogenous fertilizers of all types. It offers a worldwide service backed by 40 years of experience.

NOTE: Formulas and percentages are on a theoretical basis. Fertilizers are produced in various grades.

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

CABLES: CHEMICONST, NEW YORK

TECHNICAL REPRESENTATIVES: CYANAMID PRODUCTS LTD., LONDON • CHEMICAL CONSTRUCTION (INTER-AMERICAN) LTD., TORONTO • SOUTH AFRICAN CYANAMID (PTY) LTD., JOHANNESBURG

CHEMICO CHEMICAL CONSTRUCTION CORP.

Chemico plants are profitable investments

These Dollars Are Gone Forever!

Many, many companies in the petro-chemical field sign a blank check every year payable to The Korrosion Kids. And some of these companies never know what the corrosion of tube in heat exchangers and condensers is costing them.

But—here's a tip! You can save much of this money if you always use the *right* copper-base alloy condenser tube for the corrosive conditions you encounter. That way, you can be sure that your installation will stand up on the job.

Wolverine produces prime surface condenser tube in the following alloys: copper; Admiralty and inhibited Admiralty; cupro-nickle 70-30, 80-20, 90-10; aluminum brass; red brass 85%; and Muntz metal.

To help you pick the right alloy and to answer your questions relative to tubing, Wolverine has set up a Field Engineering Service. Call on them—*any time*. And to help you even more, Wolverine has just published a handy corrosion chart which tells you at a glance the action of various substances on copper and copper-base alloy tubing. You can have one—and a copy of our new condenser tube book—if you write today. No obligation, of course! Wolverine Tube Division of Calumet & Hecla, Inc., 1437 Central Ave., Detroit 9, Michigan.

EST. 1916

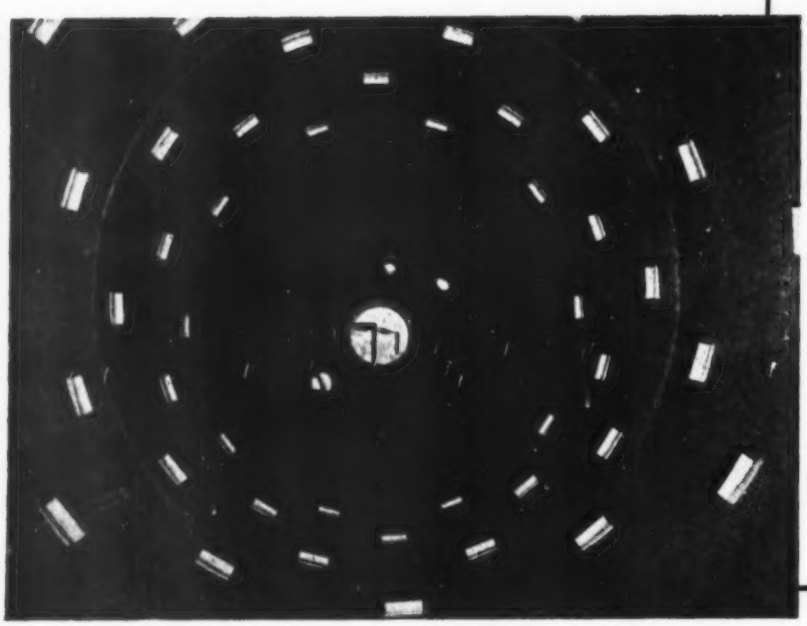
WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC.

Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA • Sales Offices in Principal Cities

EXPORT DEPT., 13 E. 40th ST., NEW YORK 16, N.Y.

Plus Values of B&W CROLOY-

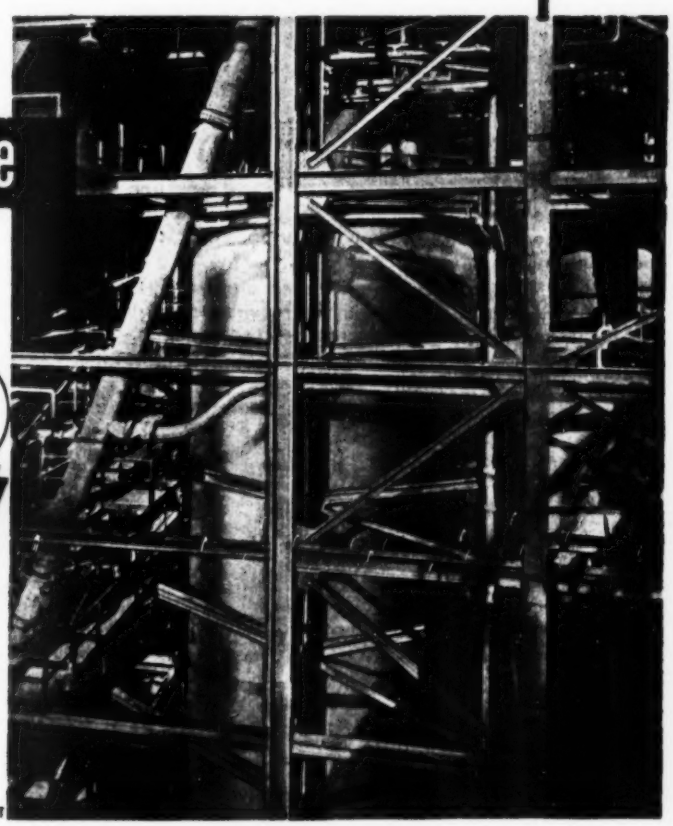


So effective is the bond between base metal and alloy liner in B&W Croloy-Clad pressure vessels that inside welded assemblies are attached directly to the stainless "skin." This faster, more economical and efficient type of assembly leaves the corrosion-resistant lining intact . . . eliminates cut-outs and welding to base metal . . . avoids the accelerated local corrosion that may result from alternative practices.

CLAD PLATE
pay dividends here

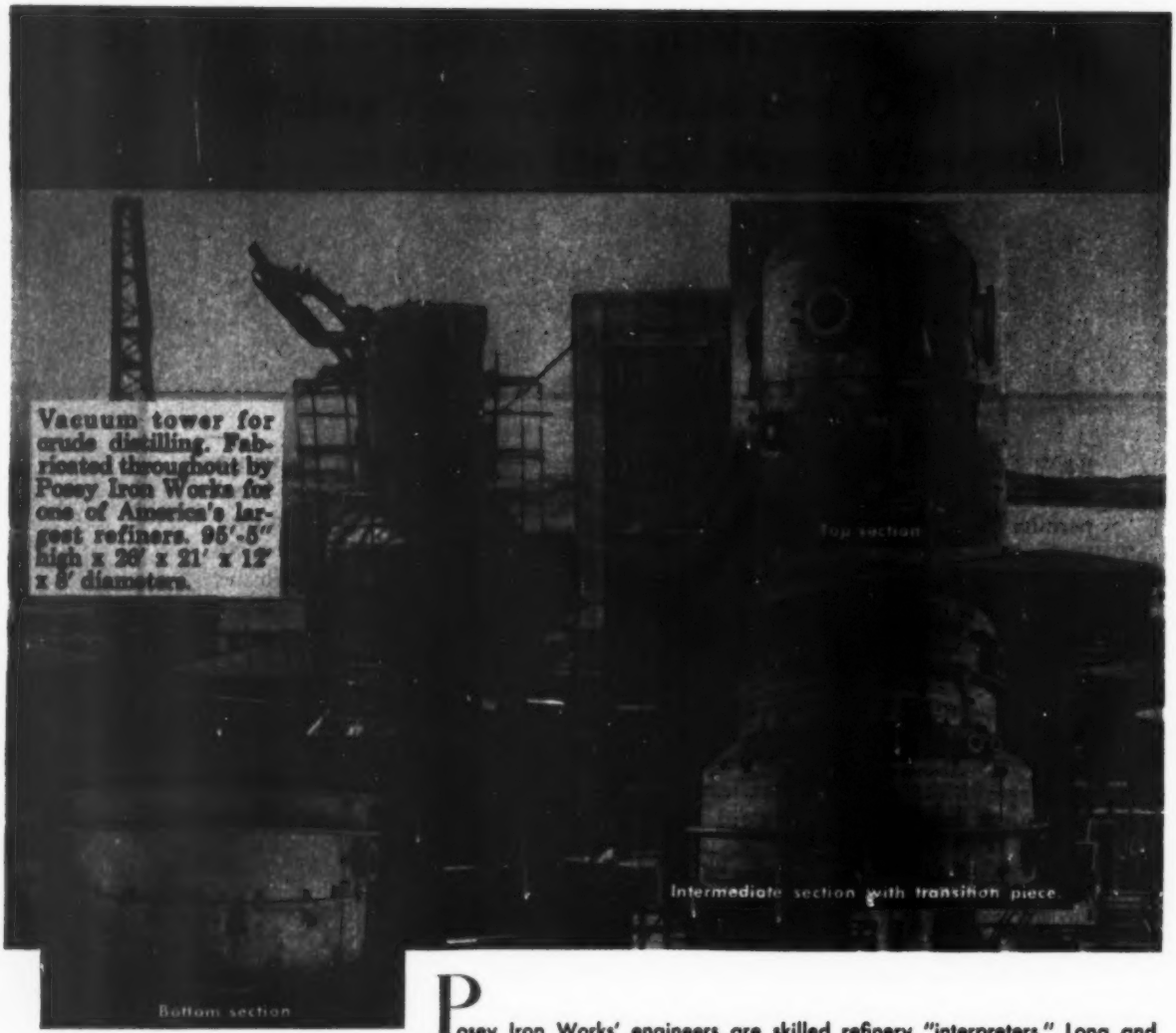
B&W Croloy cladding and base plate are permanently bonded with resistance welds • Bond withstands repeated heating and cooling • High strength of bond permits direct welding of internal fittings to Croloy lining • Uniform clad protection over full plate • Full corrosion resistance retained by heat treatment • No interface carbon migration between base metal and Croloy lining • Fabricates as easily as plain steels, and without special precautions • Provides all advantages of solid alloy protection at a great saving in cost

These features briefly explain why pressure vessels and other processing equipment built of B&W Croloy—Bonded Plate are paying dividends in dependable, lasting contact-side protection against corrosive and oxidizing conditions. Ask for Bulletin S-14. The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.



S-4187

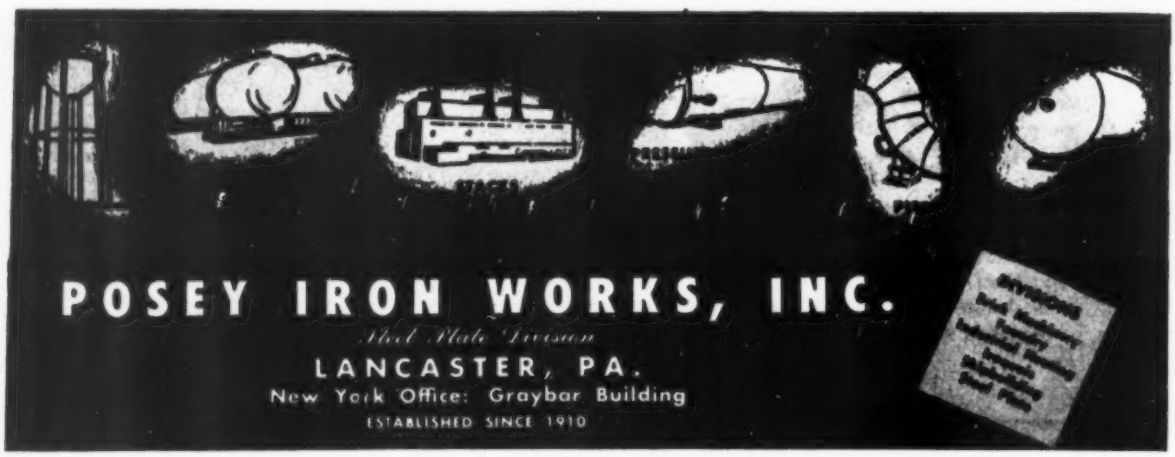
For more data on advertised products, use Readers' Service Cards, last page.

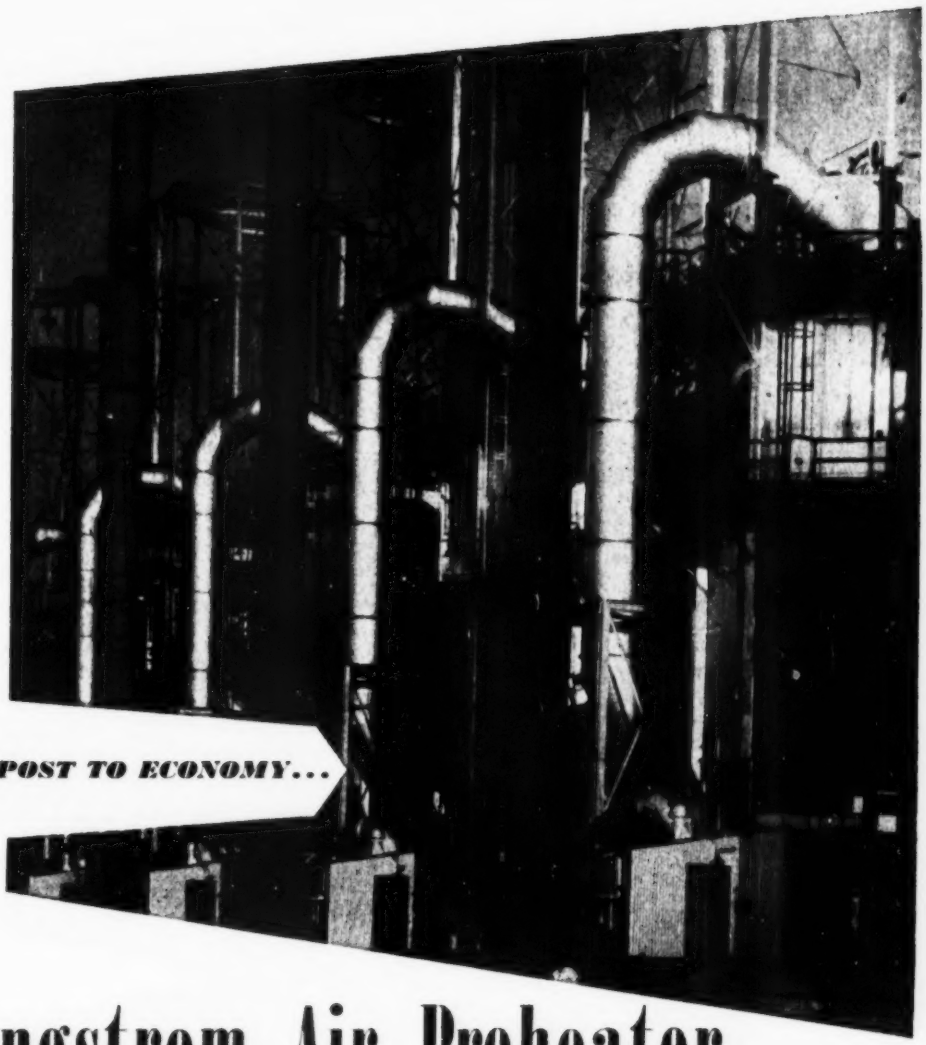

Vacuum tower for crude distilling. Fabricated throughout by Posey Iron Works for one of America's largest refiners. 95'-5" high x 26' x 21' x 12' x 8' diameters.
Top section
Intermediate section with transition piece
Bottom section

Posey Iron Works' engineers are skilled refinery "interpreters." Long and practical service to the oil field has taught us to translate into *refinery* terms such factors of steel plate fabrication as sectional construction . . . loads . . . pressures . . . capacities . . . fire protection requirements . . . steels . . . alloys . . . and specialized structures.

All Posey Iron tanks and vessels are tested to a considerable excess over working pressures. Products are designed and built to comply with the requirements of the ASME; API-ASME; API and other codes. The Posey Iron Works is authorized to apply the appropriate code symbols.

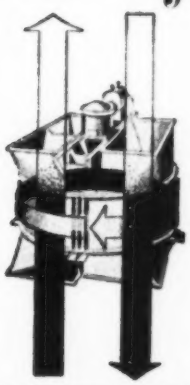
Talk over your steel and alloy steel plate fabrication needs with Posey Iron. You'll find we talk your language.





GUIDEPOST TO ECONOMY...

The Ljungstrom Air Preheater



The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

Every year, the process industries consume hundreds of millions of barrels of fuel. Refineries alone, for example, use up more than 200,000,000 barrels annually for processing crudes. This vast quantity of fuel represents probably the *greatest single item* in operating expense. If lower costs are to be realized, serious thought must be given to heat-conservation equipment.

The Ljungstrom Air Preheater offers the process industries a chance to save as much as *20% of the fuel needed for process work.* This fuel saving, plus the added benefit of increased production, makes the Ljungstrom an eminently practical piece of equipment to be considered wherever fuel is burned.

Check today to see how the Ljungstrom Air Preheater will pay for itself in just a few months – and give you impressive savings for years to come. Call or write The Air Preheater Corporation for full details.

Wherever You Burn Fuel, You Need Ljungstrom

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more data on advertised products, use Readers' Service Cards, last page.

Profit-building answers to Modern

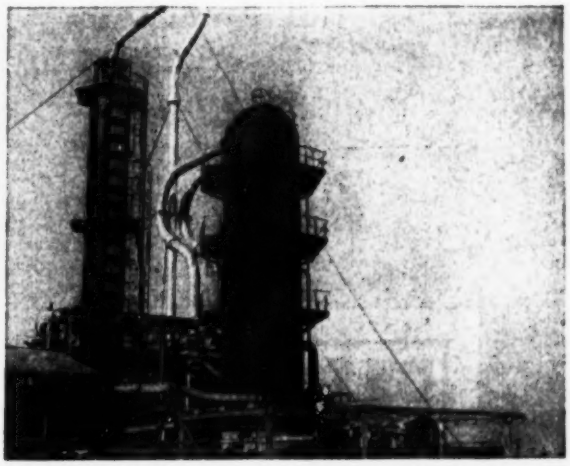
...examples of the wide variety of heavy-metal equipment designed and built by Alco to meet today's demands in petroleum and petrochemical processing . . . results of **Alco Experience** . . . gained through many years of designing and building heavy-metal equipment for refining and processing companies the world over . . . and **Alco Facilities** . . . capable of handling economically an extremely wide range of metal-fabricating operations . . . of meeting strictest customer specifications.

LARGE-DIAMETER BORING MILL, equipped with two rail heads and capable of handling work 25 ft 0 in. high, is typical of the complete, modern production facilities in Alco's shops which can produce virtually every type of heavy-metal equipment for the petroleum, chemical and power industries.

Processing problems

HEAT EXCHANGERS, built by Montreal Locomotive Works, Ltd., an Alco affiliate, ready for final piping in the Edmonton plant of The Canadian Chemical Company, Limited. Heads, tubes and tube sheets of these exchangers are fabricated of Type 316 stainless steel. MLW has supplied more than 200 heat exchangers and reboilers for this gigantic new installation.

AIR-COOLED HEAT EXCHANGERS were supplied by Alco for Celanese Corp., of America's new Pampa, Texas, plant. Mounted in 17- by 24-ft induced-draft housings, each cooling bank is equipped with two Monel fans supported on silicon rubber. Total heat dissipation from this specially engineered installation is 229,400,000 Btu per hr, a record for air-cooled condensers.

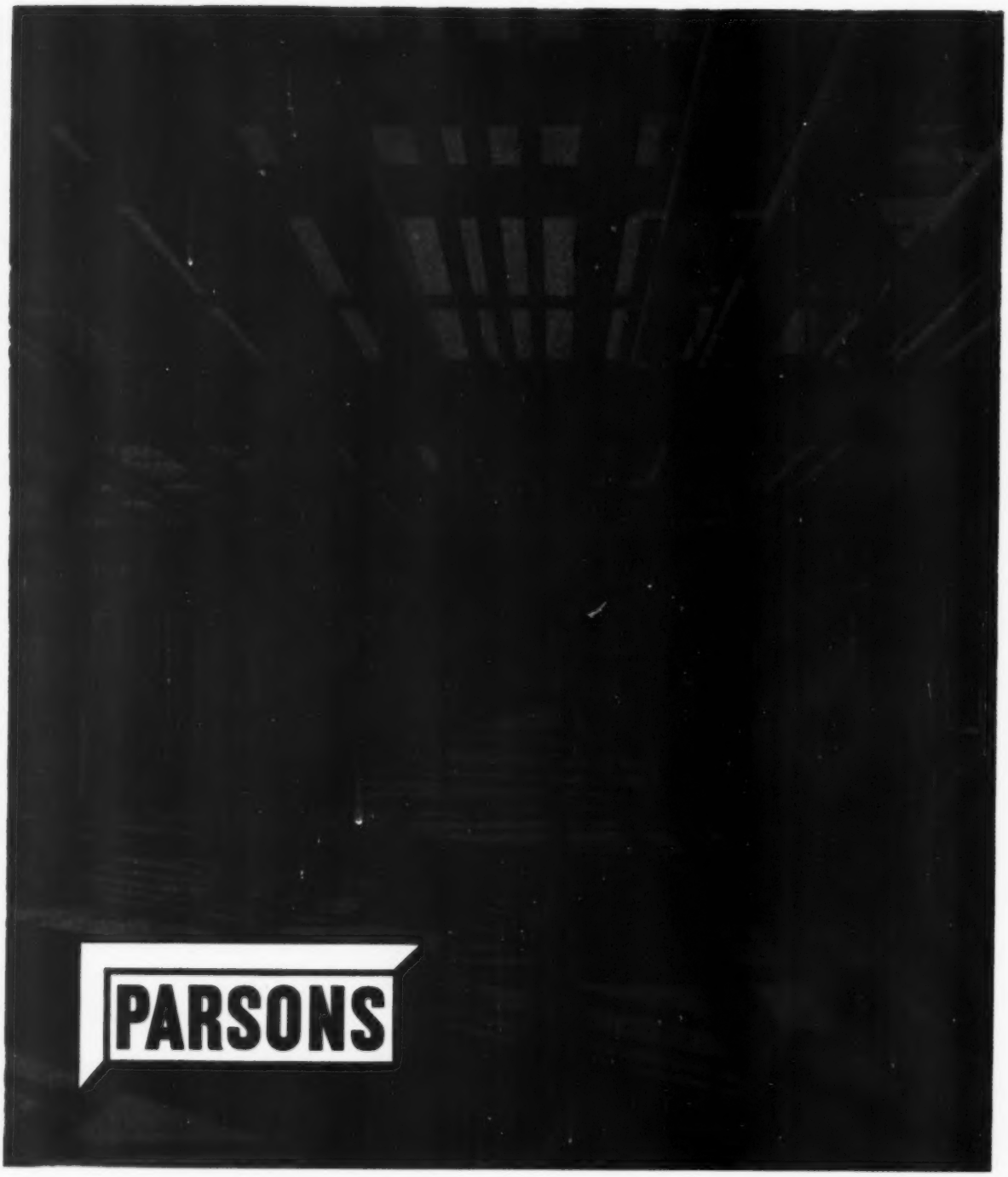


WORLD-WIDE USE of Alco equipment is typified by the wide range of Alco coolers, exchangers, condensers and heaters in service at the Aquila refinery in Trieste, Italy. Operating on Middle Eastern crudes, Aquila's annual capacity is over 900,000 tons with products including high-octane gasoline, top-quality lubricating oils and several types of asphalts and paraffin waxes.

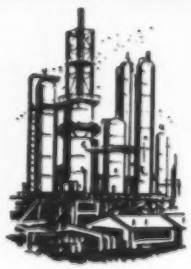
You can find your own profit-building answers by using Alco facilities and experience on your processing problems. Contact your nearest Alco Products sales representative today. Offices in Dunkirk, New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

ALCO
PRODUCTS
AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, N. Y.

For more data on advertised products, use Readers' Service Cards, last page.



Serving the petroleum industry



THE RALPH M. PARSONS COMPANY

ENGINEERS · CONSTRUCTORS

617 SOUTH OLIVE STREET, LOS ANGELES 14, CALIFORNIA

NEW YORK • TULSA • WASHINGTON, D.C. • ANKARA • BAGHDAD • KARACHI

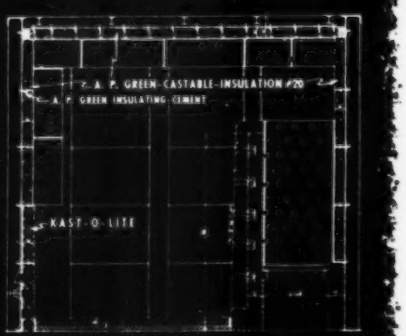
6

A P Green
REFRACTORY PRODUCTS

ONS WHY

A. P. GREEN

LIGHTWEIGHT CASTABLE REFRACTORIES REDUCE COSTS AND INCREASE EFFICIENCY IN OIL HEATERS AND OIL STILLS



Cross section drawing of an oil heater in Gary, Indiana. This heater is one example of the numerous uses for A. P. Green lightweight castable refractories in the petroleum industry.

For use in panel casing construction in new or old oil heaters and stills, A. P. Green castable refractories offer you these 6 advantages:

1. Lightweight insulating castables reduce heat loss . . . improve temperature control and heat distribution.
2. Securely anchored lining — gives long, trouble-free service.
3. Increases the performance and efficiency of the furnace. With fewer joints, air infiltration is reduced to a minimum.
4. Simplified construction — reduces erection time.
5. Lowers maintenance costs. Any tube section may be repaired by removing a series of the panels without disturbing the balance of the furnace arrangement.
6. Lower foundation costs due to the use of lightweight materials.

The A. P. Green Engineering Department will assist you with further information on the application of these materials to new units or the conversion of existing furnaces. Call your local A. P. Green distributor — he's listed in the yellow pages of your telephone directory — or write . . .

A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

In Canada
A. P. GREEN FIRE BRICK COMPANY, LTD. Toronto 15, Ontario
DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD

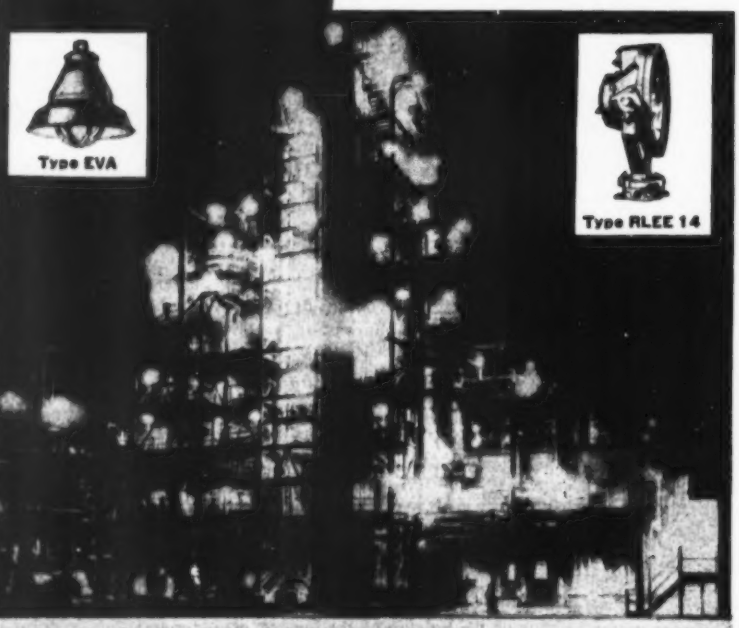
The castable is poured and anchored to the steel panels on the job site. The simple formwork has been removed and the panels are awaiting erection.

Interior view of side wall showing panels being erected.

View of outside panel casing.

You can increase production at night
CROUSE-HINDS Floodlights

. . . and they're great for protective lighting too!



A petroleum refinery lighted for round-the-clock operation with Crouse-Hinds Type EVA Explosion-Proof and Raintight Industrial Lighting Fixtures, and Type RLEE-14 Explosion-Proof Floodlights.

Production curves go up when Crouse-Hinds high efficiency floodlights are installed in yards and approaches to industrial plants.

The usefulness of many outdoor areas can be multiplied by flooding them with controlled illumination. Crouse-Hinds all-inclusive line with short, medium, and long range projectors makes it possible to get the right amount of light at the locations where it is needed. This control insures the clarity of daylight where it will do the most good, without wasteful over lighting of unused areas.

Frequently it will cost much less to project light a considerable distance with Crouse-Hinds long range floodlights than to run cable and install local lighting. There are also indoor locations in large buildings where floodlights are the most economical and satisfactory source of light.

Plenty of light is also the most reliable and cheapest form of protection against night prowlers. Sabotage and pilferage thrive in darkness. Crouse-Hinds floodlights project powerful beams of light that bathe all approaches to your property with glaring radiance, compelling everyone to be more visible than in broad daylight.

A factory yard lighted by Crouse-Hinds Type RCD-12 Lighting Fixtures. These fixtures are easy to install on buildings and are often set in the walls during construction.

This posed photograph shows the value of Crouse-Hinds searchlights for protective lighting. Their powerful beam quickly "spots" night prowlers.

FLOODLIGHTS AIRPORT LIGHTING

by using
to *turn night-time into day-time*

You will find exactly what you need in CROUSE-HINDS all-inclusive line

Explosion-Proof Floodlights. Wherever there is a possibility of the presence of explosive atmospheres, Crouse-Hinds explosion-proof floodlights will give you maximum protection. The complete line includes explosion-proof portable floodlights for temporary or emergency use.

Heavy Duty Floodlights. Crouse-Hinds line of heavy duty floodlights includes 200, 250, 500, 1000, 1500 and 2000-watt medium, and long range projectors. The slightly higher first cost is offset by lower installation and maintenance costs wherever large areas are to be lighted.

Searchlights. The mere presence of Crouse-Hinds searchlights discourages attempts at illegal entry. When such attempts are made the rascals flee in confusion the moment they are "picked up" by the powerful beam of light. Four different sizes meet every need. All can be furnished with pilot house control that permits the searchlight to be on a roof, operated from the room below.

General Purpose Floodlights. Crouse-Hinds complete line of general purpose floodlights provides efficient lighting at minimum first cost. They are widely used for lighting yards and parking lots and are ideal for industrial recreation areas and athletic fields.

Special Applications. The Crouse-Hinds line includes a number of fixtures designed for mounting in walls or ceilings for the efficient lighting of tunnels, underpasses, bridges, drives, walks, and loading areas. An ornamental lantern floodlight does a real lighting job in areas where appearance is an important factor.

A Crouse-Hinds floodlighting installation pays off in: (1) increased production; (2) prevention of accidents; (3) protection against dangerous prowlers. Pioneers in floodlighting, Crouse-Hinds illumination engineers have accumulated a wealth of lighting knowledge that is at your service. Write for additional information and ask for your FREE copy of Crouse-Hinds Bulletin 2652 "Lighting Equipment". It contains listings of hundreds of types and sizes of floodlights and explosion-proof, dust-tight, and vaportight industrial lighting fixtures.

Crouse-Hinds Type ADE-16 Heavy Duty Floodlights are used to "turn night-time into day-time" at this plant for 24-hour production.

A parking lot efficiently lighted by Crouse-Hinds Type FLA General Purpose Floodlights.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES Birmingham – Boston – Buffalo – Chicago – Cincinnati – Cleveland – Dallas – Denver – Detroit – Houston – Indianapolis – Kansas City – Los Angeles – Milwaukee – New Orleans – New York – Philadelphia – Pittsburgh – Portland, Ore. – San Francisco – Seattle – St. Louis – St. Paul – Tulsa – Washington.
RESIDENT REPRESENTATIVES Albany – Atlanta – Baltimore – Charlotte – Corpus Christi – Reading, Pa. – Richmond, Va. – Shreveport
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

A Nationwide Distribution Through Electrical Distributors

CH

TRAFFIC SIGNALS **CONDULETS**

For more data on advertised products, use Readers' Service Cards, last page.

CATFORMING *means*

SIMPLICITY

for high octanes and high yields at low cost

Simplicity is the keystone of Catforming. Why? Because simplicity takes the high cost out of high octanes and high yields.

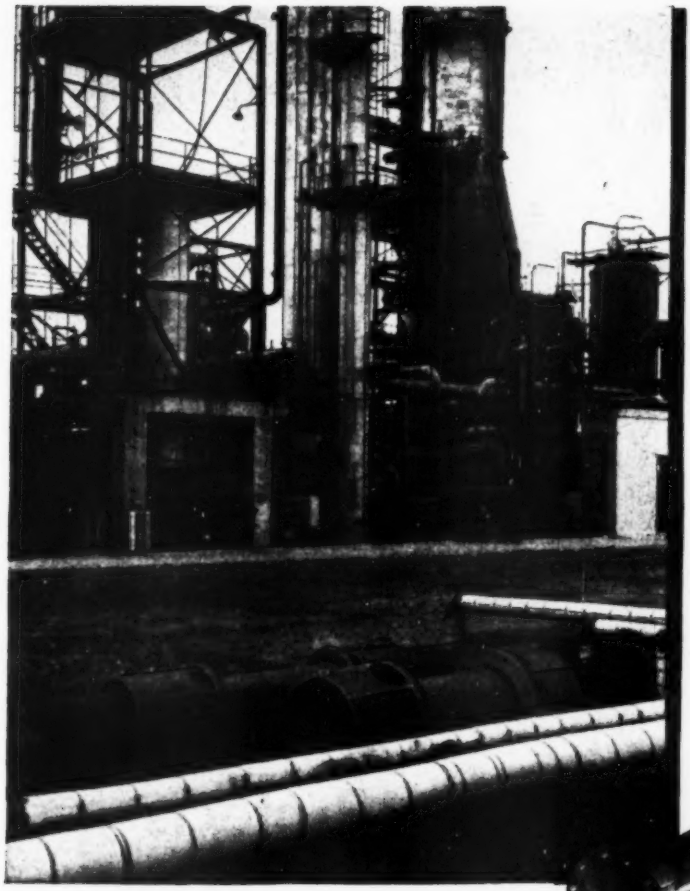
Simplicity speeds construction of Atlantic Catforming units—saving you money and time.

Simplicity makes operation of these units easy—saving you money on operating costs and manpower as well.

Simplicity means efficiency — Catforming cuts out intermediate steps in processing feed stocks, gives you high octane gasoline ready for immediate blending—and distribution.

Simplicity goes all the way with Catforming, including the licensing agreement—you'll find it well worth looking into. Remember, the performance of Catforming units has been proved in highly successful commercial operations in many areas. Write, wire or phone for detailed information — ask for our brochure, "CATFORMING." The Atlantic Refining Company, Research and Development Dept., P. O. Box 8138, Philadelphia 1, Pa.

ATLANTIC *It's the Catalyst that counts*



NEVER A SHUT-DOWN IN THIS LINE...

thanks to

ADSCO PISTON-RING EXPANSION JOINTS

● Axial movement caused by the expansion and contraction of these hot gas pipe lines at Canadian Oil Refineries, Ltd., Sarnia, Ont., is absorbed by ADSCO Piston-Ring Expansion Joints. These ADSCO joints are the only ones in the world that can be unpacked and repacked at full operating pressure and thus are of inestimable value in installations like the one shown above.

For simple maintenance, a new ring of packing can be added, but when the old packing has been allowed to become scored, it should be removed and in the ADSCO Piston-Ring Joint this can be accomplished without shutting down. When the vent valve is open, piston rings hold the line pressure while the packing is being replaced.

ADSCO Piston-Ring Joints are both internally and externally guided. Limit stops prevent slip from being pulled out of body. Chrome plating of slip cannot be scored by metal as only packing touches slip. These joints are furnished in both single and double types, in a full range of sizes, with 4", 8" and 12" traverse per slip, for pressures to 400 psi and greater, and for temperatures to 800F and higher.

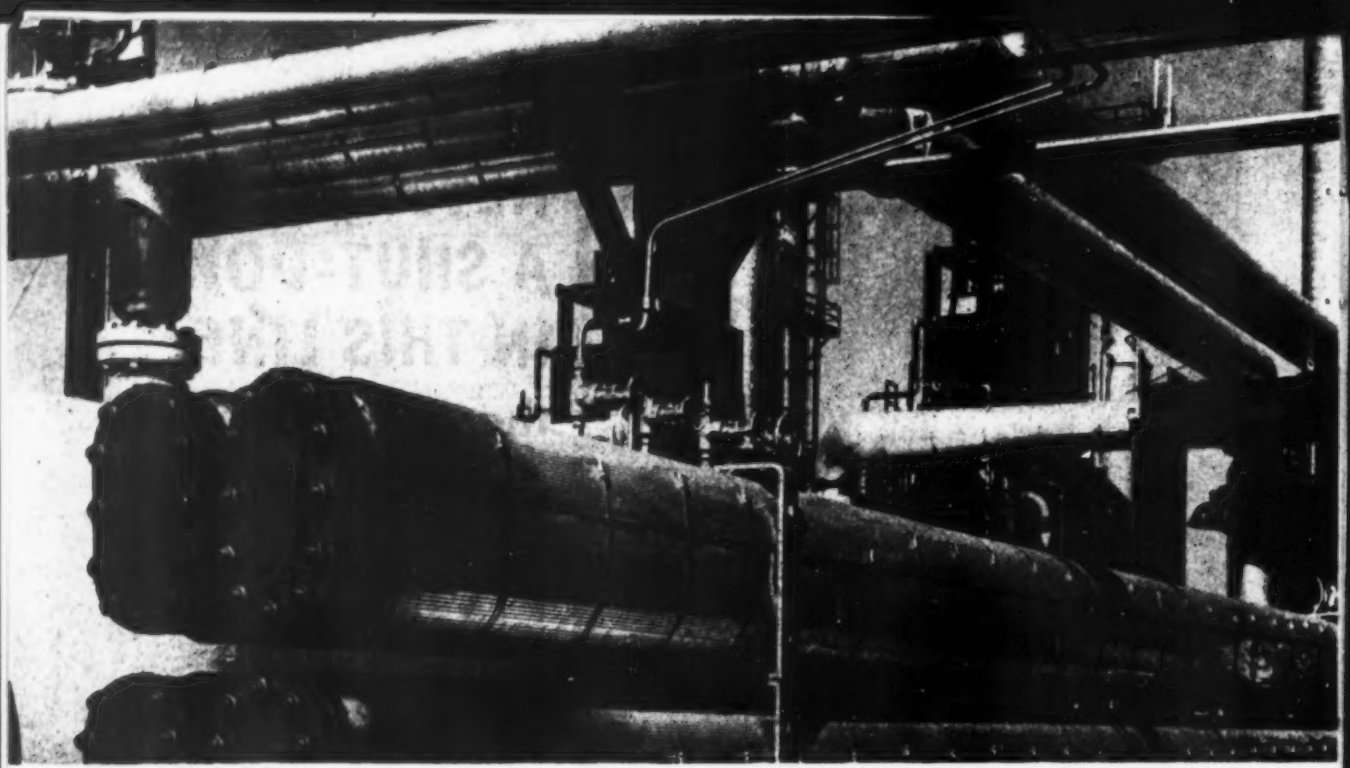
ADSCO ENGINEERED PRODUCTS FOR THE OIL, GAS, CHEMICAL AND POWER INDUSTRIES

ADSCO
ENGINEERED PRODUCTS
SINCE 1877

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS: NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.

For more data on advertised products, use Readers' Service Cards, last page.



This new kind of aluminum jacketing is used in more and more outdoor processing plants to protect insulated towers, vessels, lines—it eliminates costly maintenance and replacement of old-fashioned coverings. Engineers report that Childers Jacketing has advantages not found in expensive heavy sheet aluminum, costs less to buy, far less to apply.

New Aluminum Jacketing Protects Insulated Lines...Cuts Costs 28%

How 986 of America's Leading Companies Saved Money By Weather-proofing Insulated Lines This New Way:

A two-man crew can apply the jacketing fastest. Only tools are a pair of pliers and a wedge or screw driver as shown here. Note how easily the jacketing forms around the pipe.

Aluminum strapping can be pulled plenty tight enough with just pliers like this. No special strapping tool needed. Strapping is pulled down between lugs and bent over.

Up-to-date appearance, low cost, and long life go hand in hand in a new aluminum jacketing for insulated lines. Developed by Childers Manufacturing Co., Houston, Texas, it is the first permanent weather-proofing that offers both low initial cost and low application cost.

Childers Jacketing, made of tough 3S aluminum alloy for maximum corrosion resistance, lasts years without painting or other maintenance. It costs less than even the cheapest kind of weather-proofing, when the cost of one paint job is considered. Savings run up to 28%.

Cost-minded engineers are also impressed with the gleaming beauty of Childers Jacketing that means "good plant housekeeping."

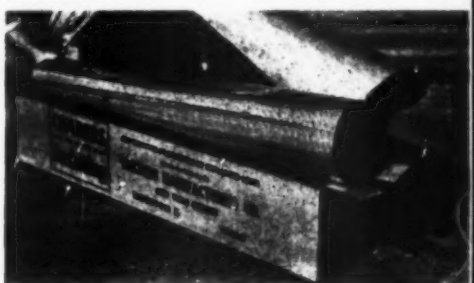
Available with moisture barrier attached, for use over 85% magnesia insulation.

5 years of tests and major installations in 986 of America's leading processing plants, refineries, and power plants have proven the advantages of Childers Aluminum Jacketing over other types.

Try this low-cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation.

Address Childers Manufacturing Co. Dept. PR-19, 3620 W. 11th St., Houston 8, Texas.

Engineering representatives in all principal cities to work with you on your problems.



This is how the flexible, easy-to-handle Childers Jacketing arrives at the job site. It is in convenient rolls 4 feet wide and 100 feet long—just right for one man to handle—and is available either with or without a moisture barrier attached on the back of the .006" aluminum "skin." It can be cut to proper lengths using any flat table and a straight-edge. (Advertisement)

BS&B Announces:

. . . An Even Better Pressure Controller — Climax Type 1440

The Climax Type 1440 Pressure Controller (non-recording) is designed to handle both positive and negative pressures, from high vacuum to pressures of up to 10,000 lbs. Bourdon Tube actuated—with all tubes, bellows assemblies, feed orifices and bleed nozzles calibrated—the Type 1440 is an instrument of utmost accuracy. Proportional band and On-Off or Maximum-Minimum snap action adjustment is easily made without additional parts. Snap action may be adjusted to pressures up to 75% of the limits of the Bourdon Tube rating.

. . . An Even Better Liquid Level Controller Pilot . . . Climax Type 1450

The type 1450 Liquid Level Controller Pilot was developed for use and mounting on any Climax Type 556, 556-LP, 557 and 559 displacement liquid level controllers where a torsion tube transmits float movements to reflect changes in liquid level or a change in gravity of the controlled liquid. Its interchangeability of parts with those of the Type 1440 Pressure Controller is an advantage which reduces stocking parts.

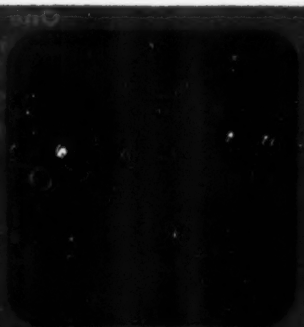
Type 1450 features a very wide "throttling" range calibrated from 5% to 100%. A specific gravity index is provided and offers a method of compensating for various gravities of liquids, or for interface services, where the "throttling" range is kept exact in its relationship to the specific gravity setting.

A special feature of the Type 1450 is its adjustability, without use of special parts, for "snap" or "on-off" action. This is useful when it becomes desirable for the displacer control valve to fully open or close when liquid level height reaches a desired "high" setting, and to remain in an opposite manner at a desired "low" setting. The amount of liquid level change from open to close position of the control valve may be varied up to [illegible]

Improved Features of Types 1440 and 1450:

1. Weatherproof case of die-cast aluminum designed for universal mounting.
2. Compact size — 8" x 8" x 4".
3. Door hinges to left or right, as desired.
4. Straight line piping.
5. Proportional bellows, calibrated, spring opposed.
6. Micro-adjusted set-point, graduated.
7. Molded diaphragms in power unit.
8. Easy parts replacement or assembly.
9. Feed orifice cleaner.
10. Snap action available over 10% to 75% of tube range without additional parts. (Applies to Type 1440 only.)
11. Pilot action reversible by moving a single link, without tools.
12. Elimination of superfluous linkages, resulting in easier adjustability and greater sensitivity.

Types 1440 and 1450 Have Been Developed and Thoroughly Field Tested for More Than Two Years!

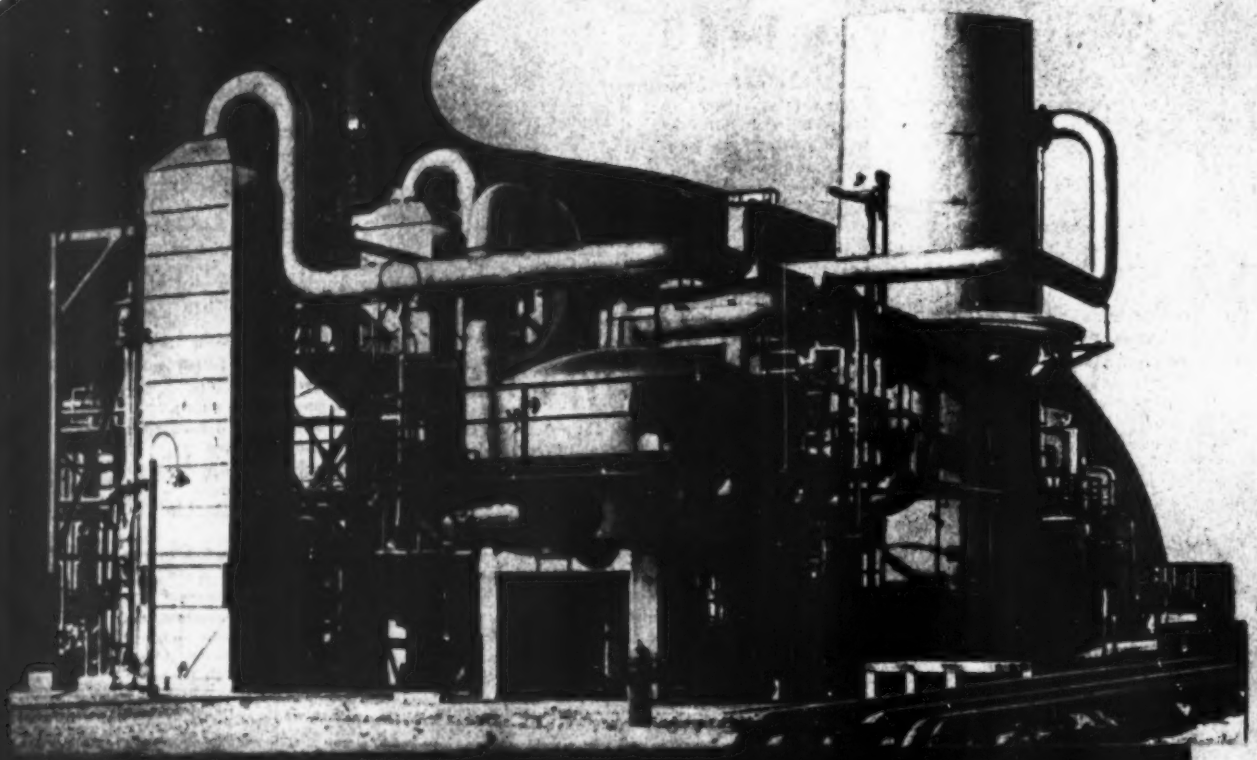


Types 1440 and 1450 are but a small part of the complete Climax line—designed, engineered and precision manufactured by BS&B to meet your most exacting requirements. Send for your free copy of the complete Climax catalog!

EFFICIENCY BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.
Climax Controls Division, Dept. 4F4
7500 East 12th Street Kansas City 26, Missouri

sulfur recovery at **FAWLEY**

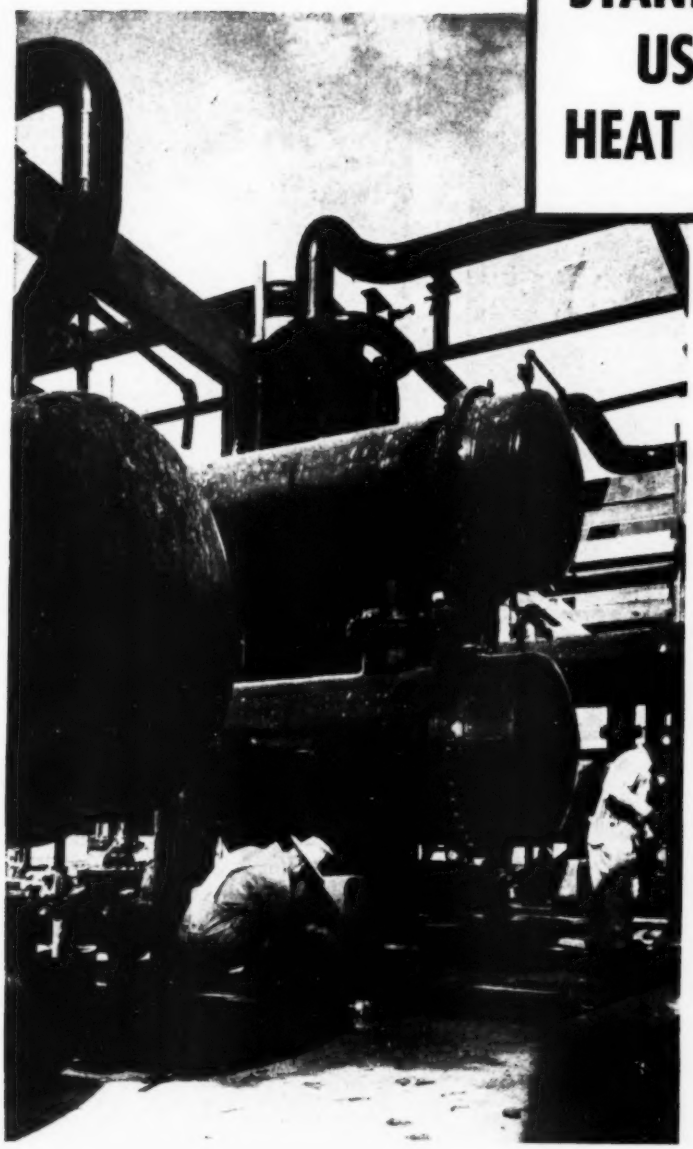


One of 18 individual process units, designed and constructed by Foster Wheeler, for this 125,000 bbl/day refinery of Esso Petroleum Company Ltd., this Sulfur Recovery unit is producing 40 Tons/day of commercially pure Sulfur for British Industry.

FOSTER WHEELER CORPORATION

165 BROADWAY NEW YORK 6 NEW YORK

STANDARD OIL OF OHIO USES ELECTRUNITE HEAT EXCHANGER TUBES



Petroleum processing is hard on Heat Exchanger Tubes. Pressure, coupled with high temperature and tough corrosive conditions, can drastically affect the life of tubing.

In severe service like this, Republic ELECTRUNITE Tubing has advantages which extend the time between retubings. Republic ELECTRUNITE Tubes go through the latest type controlled reducing atmosphere furnace. Normalizing here relieves stresses, improves grain structure and ductility. There is no oxidation, no scale forms. And the dense surface produced by cold working in forming operations is unimpaired.

Installation costs are lower, too. ELECTRUNITE Heat Exchanger Tubes have uniform wall thickness, no longitudinal thin spots. Tubes expand evenly with less danger of over or underrolling. Uniform diameter means tubes slide easily and quickly through holes in drums or headers.

Petroleum processors have benefited from the advantages of ELECTRUNITE Heat Exchanger Tubes for many years. Get these same benefits by specifying Republic ELECTRUNITE Pressure Tubes on your next order for heat exchangers or retubing. For more information, write to:

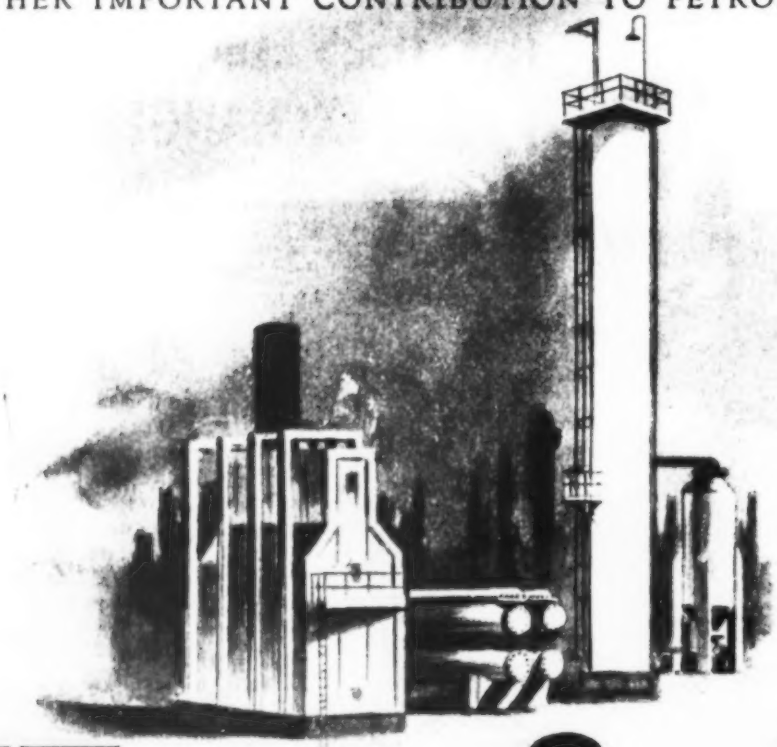
REPUBLIC STEEL CORPORATION
Steel and Tube Division
220 East 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

REPUBLIC STEEL

ELECTRUNITE

For more data on advertised products, use Readers' Service Cards, last page.

ANOTHER IMPORTANT CONTRIBUTION TO PETROLEUM PROGRESS



Unifi

A New Catalytic Refining Process to Purify Petroleum Distillates

Universal Oil Products Company is pleased to announce that the UNIFINING process is now available to the petroleum refining industry, and a refiner may secure the benefits of the combined techniques and patent rights of both Universal Oil Products Company and Union Oil Company of California through a single licensing arrangement.

The process uses a cobalt-molybdenum type catalyst to react hydrogen with petroleum distillates, saturating the olefinic hydrocarbons and removing sulfur, nitrogen, oxygen, and other impurities to the degree desired by the refiner.

Excess hydrogen from a UOP Platformer provides an excellent and economical source of hydrogen for the Unifining unit.

n i n g

Unifining is particularly advantageous for pretreating certain types of feed stocks prior to processing in a UOP Platformer. By using Unifining in combination with a Platforming unit, the refiner will find that engineering advantages accrue which will be reflected in lower costs to him.

UNIVERSAL OIL PRODUCTS COMPANY

General Offices: 30 ALGONQUIN ROAD, DES PLAINES, ILL., U.S.A.

UOP®

Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Investment

For more data on advertised products, use Readers' Service Cards, last page.

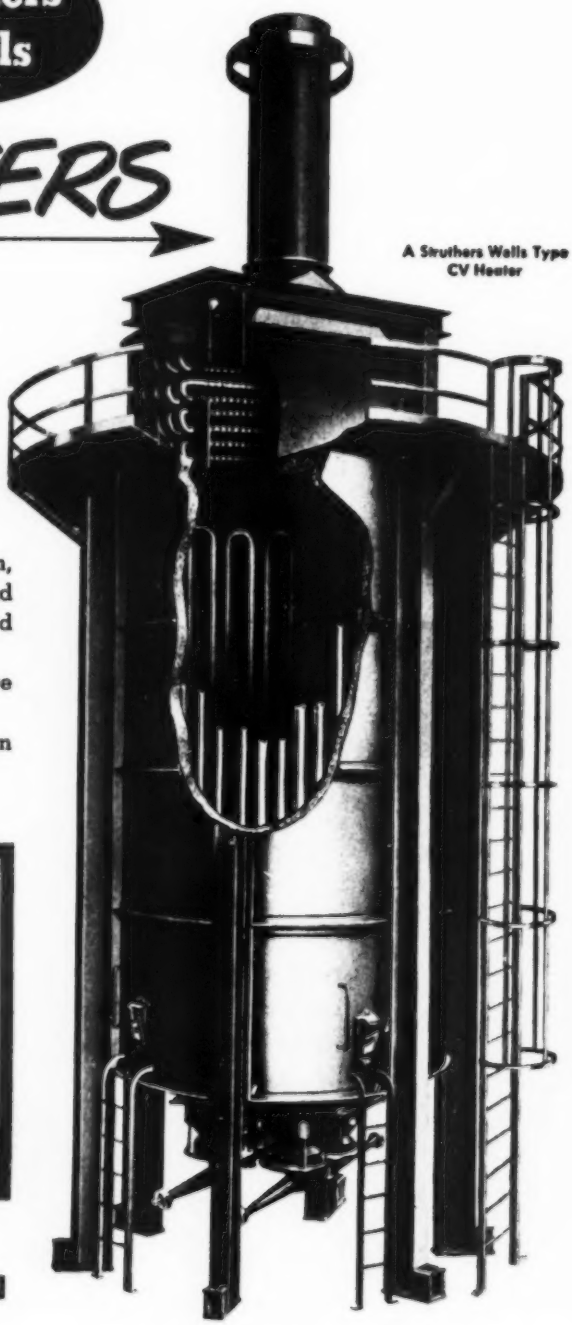
RICH OIL HEATING

for

CATALYTIC REFORMING

Specify Struthers Wells VERTICAL FIRED HEATERS

A Struthers Wells Type CV Heater



Struthers Wells Vertical Heaters are widely used throughout the petroleum industry.

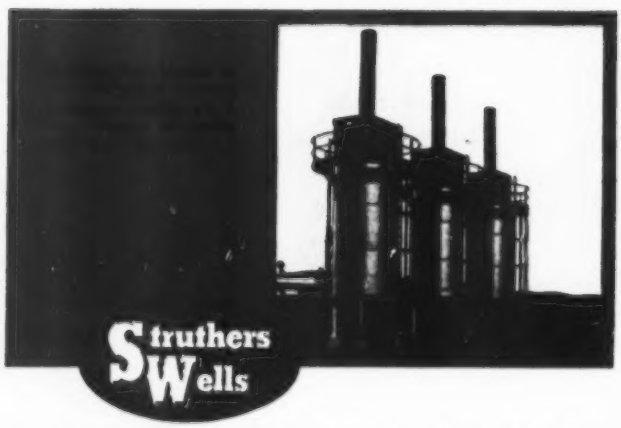
High thermal efficiencies may be secured with these Heaters—an important factor where the cost of natural gas and other fuels is increasing so rapidly.

Standard units are available in a wide range of sizes, with most equipment available for prompt shipment using stock materials.

Circulating systems are available, using oil or Dowtherm, for the indirect heating of grease kettles, reactors, and other equipment. This equipment is generally supplied complete with all accessories.

Electrically heated units for circulating heating are available for pilot plant or small scale operation.

New Bulletin C-45 is available; please send request on your letterhead.

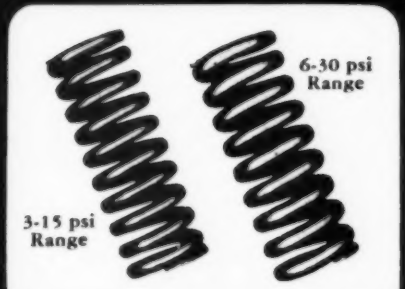


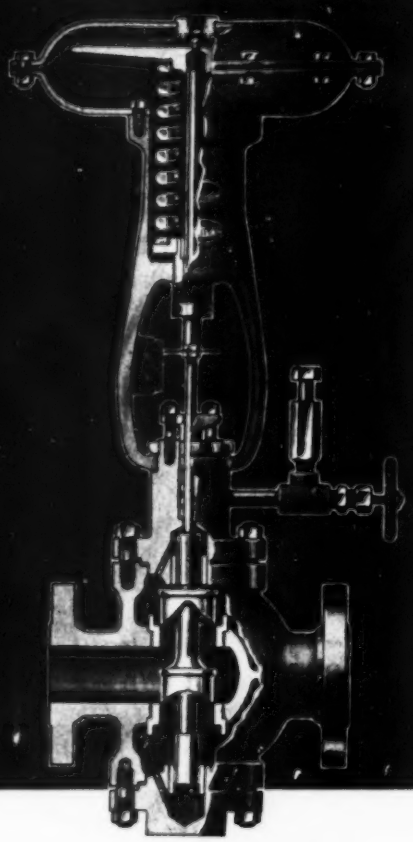
STRUTHERS WELLS CORPORATION

WARREN, PA.

Plants at Warren and Titusville, Pa. *Offices in Principal Cities*

6-30 PSI
SPRING RANGE





For Extra Power

Doubles the power to operate the valve when conditions make it desirable or necessary.

Makes initial spring force up to 4000 pounds available for large air-to-open single seated valves operating at high inlet pressures.

Provides large operating force at beginning of stroke.

But No Extra Bulk

Compact, because diaphragm motor with, for example, 200 sq. in. effective area becomes equivalent to 3-15 psi motor with 400 sq. in. effective area.

And No Extra Cost

Both 3-15 and 6-30 psi spring ranges are "standard" — there is no extra charge for the higher range.

NOTE: There is a nominal extra for *oversized* motors which give you *even greater* power where necessary.

Operating Air is No Problem

because

Masoneilan Pneumatic Controllers are available with 6-30 psi (as well as 3-15 psi) output at *no extra cost.*

Masoneilan Positioners are available with either 3-15 or 6-30 psi input and/or output at *no extra cost.*

Masoneilan Boosters (1 to 2 input-to-output ratio) may be used with 3-15 psi output instruments without positioner.

More details on the uses of this versatile spring range sent on request.

ALL HIGH Co PRODUCTS

. . . in Masoneilan Control Valves

MASON-NEILAN REGULATOR CO.
1182 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa • Philadelphia • Houston • Pittsburgh • Atlanta • Cleveland Cincinnati • Detroit • San Francisco • Boise • Louisville • Salt Lake City • El Paso • Albuquerque • Odessa • Charlotte • Los Angeles Corpus Christi • Denver • Appleton • Birmingham • New Orleans • Dallas • Seattle • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

For more data on advertised products, use Readers' Service Cards, last page.

THERE IS NO
GOOD REASON...
for you to burn money by not taking
advantage of the efficient means available for
the recovery of pure elemental sulphur
from waste hydrogen sulphide in your refinery
or natural gas operation.
Pritchard is a licensing agent for
Stanolind Oil and Gas Company's new patented
processes, practical design data and operating specifications
to provide efficient sulphur recovery.
Write today for complete information on how a
Pritchard-built sulphur recovery plant can eliminate air
pollution and produce extra profits for you.
Industry's Partner for Progress
J.F. Pritchard & Co.
ENGINEERS • CONSTRUCTORS
Dept. 372, 210 West 10th St., Kansas City 5, Mo.
CHICAGO • HOUSTON • NEW ORLEANS • NEW YORK
PITTSBURGH • ST. LOUIS • TULSA
SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

MODERN EQUIPMENT and closest attention to every casting detail enable new Aloyco foundry to turn out the finest corrosion-resistant valve castings made.

New Aloyco foundry helps process industries in record expansion

PATTERN SHOP. In this well-equipped shop seasoned craftsmen make extremely accurate wood or metal patterns for valves of any size or complexity

During 1954, almost half the nation's total investment in new plants and equipment will go into the chemical and petroleum industries.

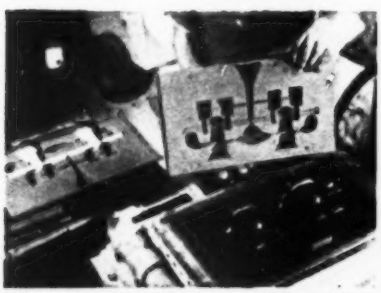
To meet their unprecedented needs for processing equipment, our new specially-equipped foundry will substantially increase the production of Aloyco corrosion-resistant valves.

For 25 years, Aloyco, the world's largest specialist in high alloy valves, has been helping the chemical process industries master valve corrosion problems. Alloy Steel Products Co., Inc., 1301 West Elizabeth Avenue, Linden, New Jersey.

Plants: Linden, N. J., Bloomfield, N. J., Elizabeth, N. J.

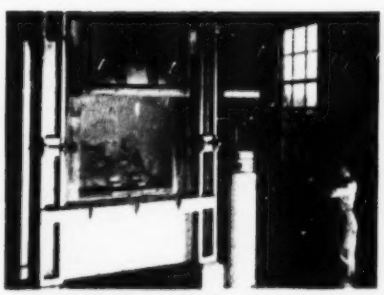
DISTRICT OFFICES

NEW YORK 1, N. Y. — 350 Fifth Avenue
WILMINGTON, DEL. — 226 West Ninth St.
PITTSBURGH 22, PA. — 318 Investment Bldg.
ATLANTA, GEORGIA — 333 Candler Bldg.
ST. LOUIS, MISSOURI — 1221 Locust St.
CHICAGO 4, ILLINOIS — 332 So. Michigan Ave.
BUFFALO 14, N. Y. — 3053 Main St.
HOUSTON 6, TEXAS — R. E. Lugar Co. 2716 Danville St.
SAN FRANCISCO, CALIF. — 24 California St.
LOS ANGELES 22, CALIF. — 5442 Jillson St.



SHELL MOLDING. Up-to-date shell molding facilities assure users of the greatest contour accuracy in castings for small and medium-sized Aloyco valves.

INSPECTION AND HEAT STAMPING. Castings are carefully inspected, their "pedigrees" stamped in. Any not 100% perfect are remelted, never welded or patched.



HEAT TREATING. After cleaning, all Aloyco austenitic type castings are heat treated and water quenched to insure maximum corrosion resistance.

Sunset AT 3-BAR RANCH

Day after day through the years gas produced from oil wells on the 3-Bar Ranch in Andrews County, West Texas, will be gathered, compressed, processed, and reinjected into the producing formation — resulting in the production of many hundreds of thousands of barrels of otherwise unrecoverable crude oil, the extraction of millions of barrels of liquid hydrocarbons from the gas, and the availability for markets in future years of a large dry gas supply.

Hudson designed and constructed the plant in collaboration with Stanolind Oil and Gas Company. Stanolind operates the plant and shares in its ownership with Humble Oil and Refining Company, Champlin Refining Company, and the Superior Oil Company.

The facilities are designed to compress casinghead gas to a reinjection pressure of 2,700 pounds per square inch, and to recover from the gas heavier hydrocarbons which are fractionated into liquid products.

Designers and Constructors of Oil and Gas Processing Plants

HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

INCREASE throughput capacity
ELIMINATE costly liquid loss
IMPROVE overhead product quality
REDUCE harmful air pollution
with

YORKMESH DeMISTERS

CASE STUDY No. 1001

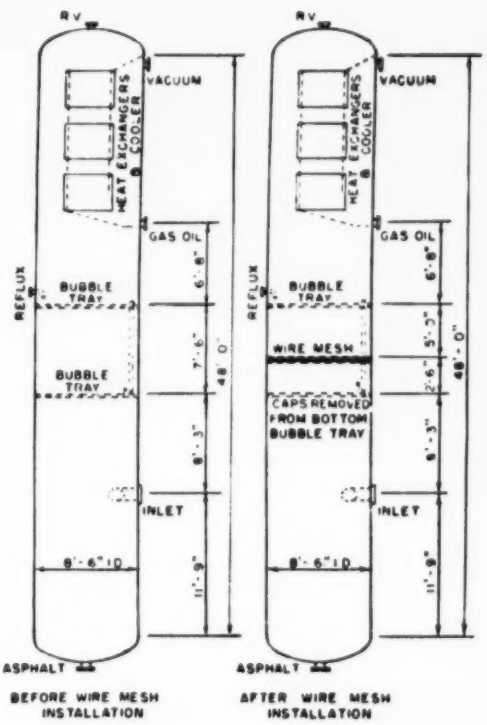
ENTRAINMENT ELIMINATION GIVES 31% CAPACITY INCREASE

OBJECTIVE:
To increase throughput capacity in an 8 ft., 6 in. diameter asphalt vacuum still.

PROBLEM:
Due to asphalt entrainment, the carbon content of the gas-oil at feed rates above 3200 bbl. per day was too high for satisfactory cat-cracker operation.

SOLUTION:
A single 4" thick Yorkmesh Demister, installed below the top bubble tray, eliminated substantially all of the asphalt entrainment.

RESULTS:
Throughput was increased from 3200 to 4200 bbl. per day (31% increase) while producing equivalent or better quality gas-oil and asphalt.

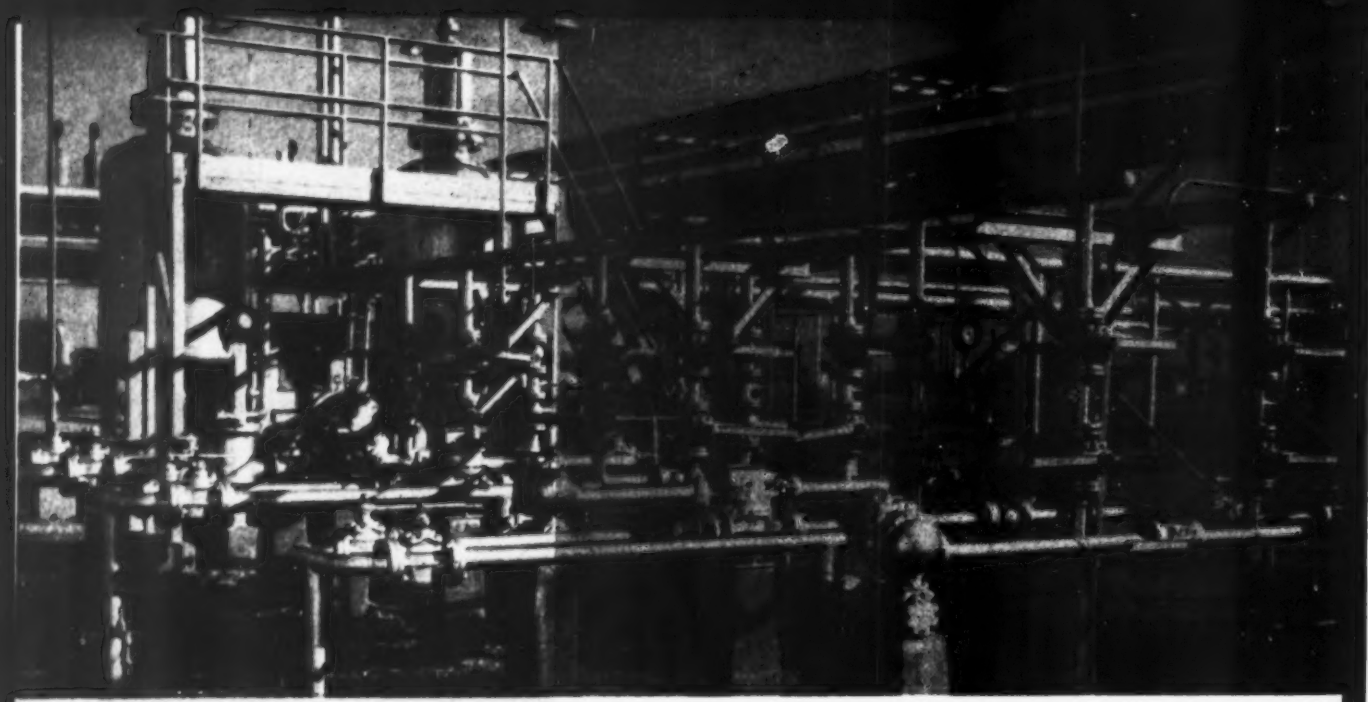


Note: For the full story of how this single 4" Yorkmesh Demister pad increased tower capacity 31% while improving quality, send for case study #1001

YORK

OTTO H. YORK CO., INC.
69 GLENWOOD PLACE, EAST ORANGE, N. J.

For more data on advertised products, use Readers' Service Cards, last page.



Refinery Tubing Problems?

We specialize in solving them

● Before you select refinery pipe and tubes, perhaps we can help you in the many problems you must face: basic differences in equipment, variations in fabricating operations, service pressure, high or low temperature conditions, presence of corrosive media, etc. Individually or collectively, all of these factors enter into determination of the best pipe or tube material for your particular service conditions.

You aren't expected to be a tubing expert—it isn't part of your job. It's ours. Our *specialty* is tubing. Through research and laboratory experimentation, through on-the-scene observations, and by studying actual installations, we at National Tube have built up an "experience file"—a collection of case histories that date back through 60 years of solving tubing problems. We want to share this experience with you.

To meet the increasingly more rigorous demands of refinery service, National Pipe and Tubes have been constantly improved until now we are able to offer you seamless tubing, condenser and heat exchanger tubes, and refinery piping in a wide range of analyses—25 of which are listed at the left. Each of these 25 analyses meets the specific requirements of corrosion and oxidation for which it is recommended. Other chemical compositions are also available in tubular products, and a wide variety of high temperature problems are now under study.

Examine the list of analyses. Then, before you choose your new piping or tubing, get in touch with our engineers. In that way, you'll be certain to get the right analysis for your particular requirements. Our recommendations are a service to you, putting you under no obligation.

National Tube's 25 different steel tube analyses:

Carbon	5 Cr, ½ Mo	18-8
Carbon, ½ Mo	5 Cr, ½ Mo, 1½ Si	18-8 Ti
½ Cr, ½ Mo	7 Cr, ½ Mo	18-8 Cb
1 Cr, ½ Mo	8 Cr, ½ Mo	18-8 Mo
1¼ Cr, ½ Mo	8 Cr, 1 Mo	25-20
2 Cr, ½ Mo	9 Cr, 1 Mo	3½ Ni
2¼ Cr, 1 Mo	12 Cr	5 Ni
2½ Cr, ½ Mo, ⅓ Si	12 Cr, Al	
3 Cr, 1 Mo	17 Cr	

WALLS WITHOUT WELDS

NATIONAL TUBE DIVISION,
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS NATIONAL SEAMLESS PIPE AND TUBES

USS

UNITED STATES STEEL

Which of these is your pumping problem?

Name just about any fluid you consider "hard to handle" and we will show you a De Laval pump that will do the job efficiently and at low cost.

De Laval IMO and CPO pumps have solved problems on a wide range of products—hot or cold, acidic or alkaline, viscous or corrosive, clear or filled with suspended solids. IMO and CPO models are available for early delivery.

Your De Laval representative is an experienced application engineer. Consult him on your pumping problems.

DE LAVAL IMO PUMPS
capacities to 750 gpm
pressures to 1500 psig
Write for Bulletin LG-4

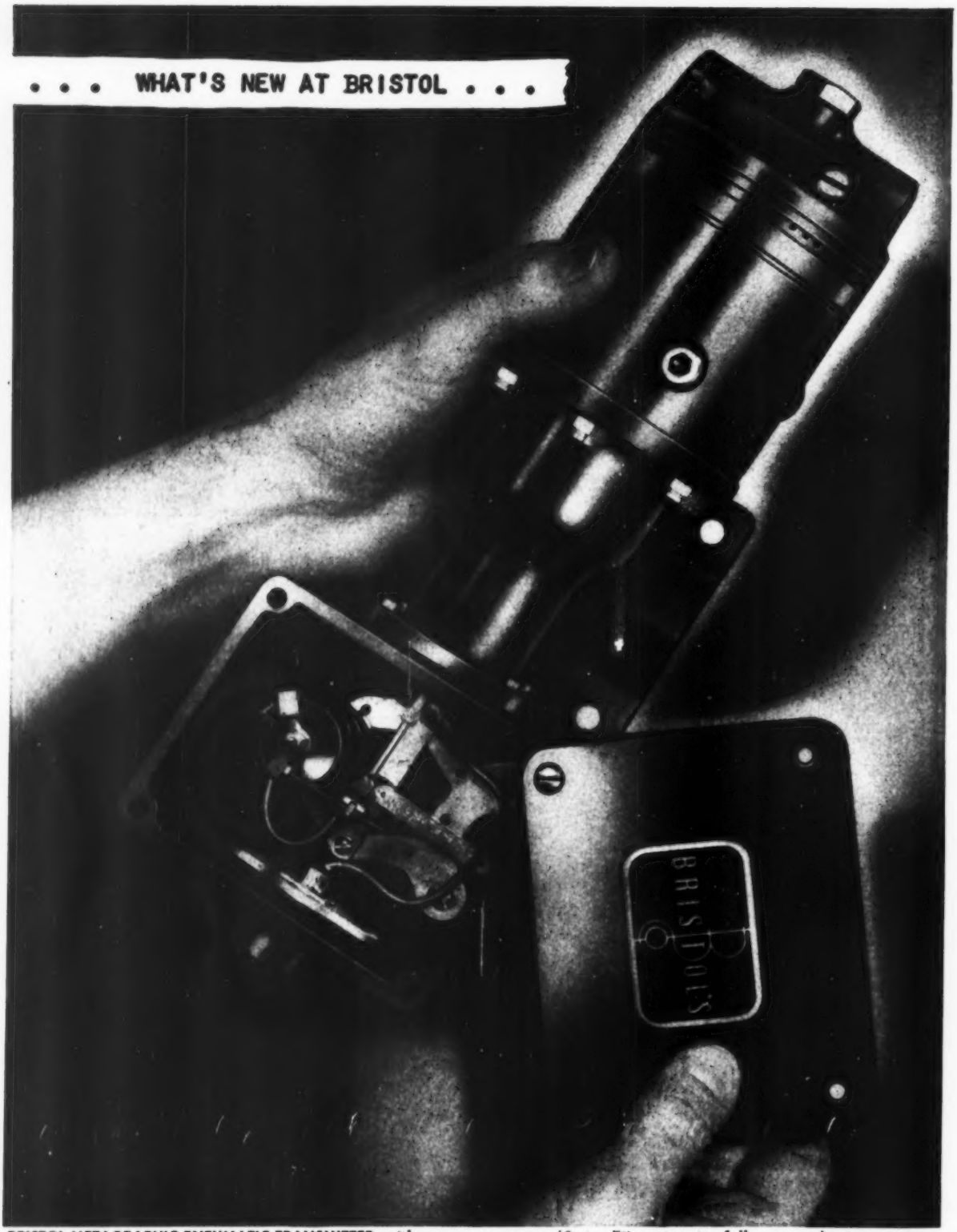
DE LAVAL CPO PUMPS
capacities to 2000 gpm
heads to 200 feet
Write for Bulletin 1125-B

DE LAVAL *Pumps*

DE LAVAL STEAM TURBINE COMPANY
811 Nottingham Way, Trenton 2, New Jersey

DL 236A

For more data on advertised products, use Readers' Service Cards, last page



BRISTOL METAGRAPHIC PNEUMATIC TRANSMITTER, with cover removed. The frictionless transmitter, with only one pivot and no flexures, will operate in any position, indoors or out. The unit is sensitive to extremely small changes in the measured quantity, as minute as 0.03% of range, including reversal. You can get the Metagraphic transmitter in a wide selection of ranges: Pressure (0 to 5″ water to 0-10,000 psi), vacuum (0 to 5″ water to full vacuum), temperature (—100° F to 1000° F), liquid level (0 to 5″ water and up), flow (mercury manometer, bell type, and Barton meter bodies), and differential pressure (0 to 2.0″ water to 0-500″ water). Suppressed ranges are available. Over-range protection is standard with the Metagraphic transmitter, up to 500% for some ranges.

Simplicity?

LOOK INSIDE!

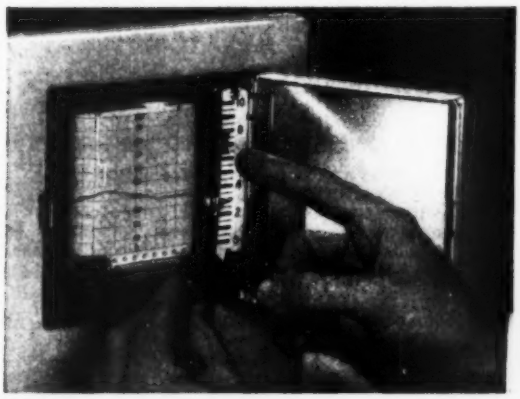
• When you remove the cover from one of Bristol's Metagraphic pneumatic transmitters, you're quickly aware of the inherent simplicity of Bristol's world-famous measuring element. This unit, the result of years of measuring element research and development, has operated in Bristol instruments that have chalked up as much as 35 years continuous service without attention.

Here are some of the features of the Metagraphic transmitter, designed to give you new standards of accuracy and reliability in measuring and transmitting readings of temperature, pressure, vacuum, differential pressure and liquid level.

- **NON-BLEED BOOSTER PILOT** for low air consumption. In the balanced position, air consumption is only 0.07 scfm.
- **HIGH-SPEED TRANSMISSION** and superior control result from large air capacity of the pneumatic relay – 3.0 scfm.
- **INDICATING DIAL GAUGE,** to show output pressure, can be screwed into front of transmitter. No piping or fittings are needed.
- **WEIGHS ONLY 7½ POUNDS,** is weatherproof and can be installed in any location and operate in any position.

Get the whole story on the Metagraphic transmitters. Write for free bulletin A105, to The Bristol Company, 111 Bristol Road, Waterbury 20, Connecticut.

Meet the rest of the Metagraphic family . . .



BRISTOL'S "HUMAN-ENGINEERED" METAGRAPHIC RECORDER, with its easy-to-read scale, high-visibility fluorescent pointers and shadow-proof door has earned a reputation as the "biggest little instrument in the industry". The continuous valve-position indication, separate from set-point indication, gives continuous data on control valve position and process level.

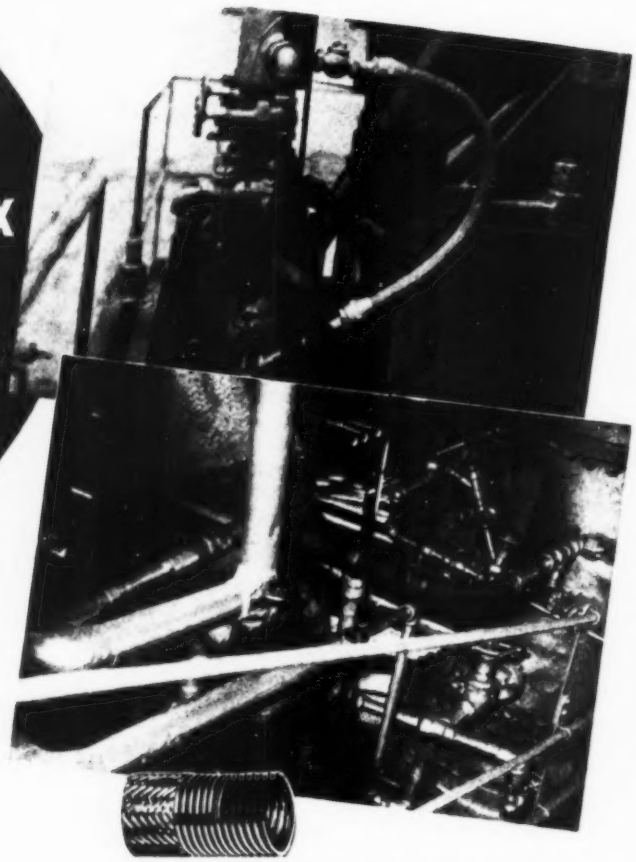
THE BRISTOL CONTROLLER can be plugged into back of receiver, placed at process. Available in on-off, proportional, proportional plus reset, proportional plus derivative, and proportional plus reset plus derivative. Experienced instrument men will recognize this as a unit* service-proved in thousands of installations.
*Licensed under C. B. Moore patents

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

NOW
INDUSTRIAL REX-FLEX
Heavy Wall
Stainless Steel
HOSE



Available in four types to meet every industrial need

TYPE RF-44—Annularly corrugated; sizes from 2½" through 6" I.D. for working pressures to 40 psi.

TYPE RF-45—Same as Type RF-44, but with metal braid covering for working pressures to 410 psi.

TYPE RF-54—Helically corrugated; sizes from ¼" through 2", I.D. for working pressures to 440 psi.

TYPE RF-55—Same as Type RF-54, but with metal braid covering for working pressures to 3100 psi.

To meet the growing demand for heavy duty stainless steel hose, Flexonics Corporation now offers new heavy wall Industrial REX-FLEX. Backed by unmatched experience in the manufacture of corrugated stainless steel, steel and bronze hose, the new Industrial REX-FLEX marks an important step forward in the development of corrosion-resistant hose that can stand the gaff of rugged industrial service, and still maintain maximum flexibility.

A complete range of flanged or screwed fittings may be used, attachment being made by silver brazing or atomic hydrogen welding.

See your industrial distributor, or write for data sheets giving full specifications on Industrial REX-FLEX.

TYPICAL APPLICATIONS FOR INDUSTRIAL REX-FLEX

- *Weigh tank connections*
- *Superheated steam*
- *Conveying corrosive gases and liquids*
- *High temperature connections*
- *Vibration connections*
- *Vacuum hose*
- *Fireproof connections*
- *Conduit*
- *Offset motions*
- *Continuous flexations*
- *Air ducts*
- *Exhaust connections, etc.*

WRITE FOR CATALOG

Industrial REX-FLEX is part of Flexonics' complete line of flexible metal hose. All types are described in Catalog 130-R. Or see the Flexonics' catalogs in Sweets, Chemical Engineering Catalog or Refiners Catalog.

Flexonics Corporation

CHICAGO METAL HOSE DIVISION
1336 S. THIRD AVENUE • MAYWOOD, ILLINOIS

FORMERLY CHICAGO METAL HOSE CORPORATION
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

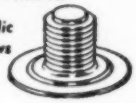
Flexon identifies products of Flexonics Corporation that have served industry for over 52 years.

Flexible metal hose

Expansion joints

Aircraft components

Metallic bellows



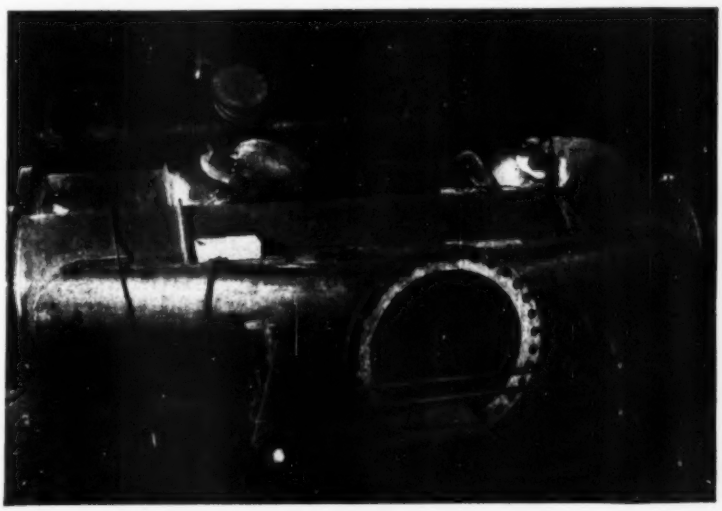
PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY APRIL-MAY 1954

3,360 Red Brass Tubes for This Condenser

Shown on one of Kellogg's boring mills (below) where the gasket face is being machined, this is a channel for one of four sections of a prefractionator condenser currently underway for a southwestern petroleum refinery.

Each bundle of the condenser will contain 840 tubes, $\frac{3}{4}$ inch in outside diameter by 16 feet in length. The water available for industrial purposes in the particular area where the condenser will be used is especially corrosive. To offset this, specifications call for red brass as the material for the tubes, this alloy having proved by experience to give the most effective protection against corrosion in the locality involved.



Tube sheets for the condenser will be of steel, clad with naval brass. Shell, shell cover, and channel are of steel. Design temperature is 200°F. on the shell side and 150°F. on the tube side.

Big Condenser Will Hold Pressure Drop to 5mm. Maximum

The drip-type condenser shown above in progress in Kellogg's shop has been designed to hold pressure drop on the shell side to the exceptionally low maximum of 5 mm. of mercury. Consisting of two sections, the unit will condense naphtha vapors and steam on the shell side and heat a petroleum distillate on the tube side. Operating pressure on the shell side will be 65 mm., and 150 psi. on the tube side.

Representative of one of the more complex types of exchanger units Kellogg is experienced in building, in addition to all the conventional types, this condenser is designed with an obround nozzle to spread the incoming vapors over the entire length of the tube bundle, thus providing for pure cross-flow heat transfer.

44,000-lb. Reactor for New Chemical Process

Similar in design to units refiners use in transforming certain petroleum gases into polymer gasoline, this big reactor (right) will shortly become an important part of a new chemical plant now building on the East Coast. The plant will be the first in this country to manufacture phenol from cumene, an intermediate material which in turn is obtained from benzene and propylene. This particular unit is the vessel in which the reaction to produce cumene will be carried out.

The tubular reactor is $3\frac{1}{2}$ feet in internal diameter by $35\frac{1}{2}$ feet in length, and is fabricated of high-tensile carbon steel, $1\frac{5}{8}$ inches thick. When completed, it will tip the scales at some 44,000 pounds. The unit is designed for an internal pressure of 990 psi, and temperature of 510°F.

FABRICATED PRODUCTS DIVISION
M. W. KELLOGG
KELLOGG PULLMAN

*FIRST LINE *Extended-Surface* HEAT EXCHANGERS

ASK THE AEROFIN MAN

Specify Aerofin and you specify high efficiency, long service life and low maintenance and service costs.

Take advantage of Aerofin's unequalled experience, production facilities, and materials-testing and design research—of Aerofin's complete engineering service at the plant and in the field.

Ask the Aerofin man.

* Aerofin makes extended heat surface exclusively — not as a by-product, not as a side-line. Sold only by manufacturers of fan-system apparatus. List on request.

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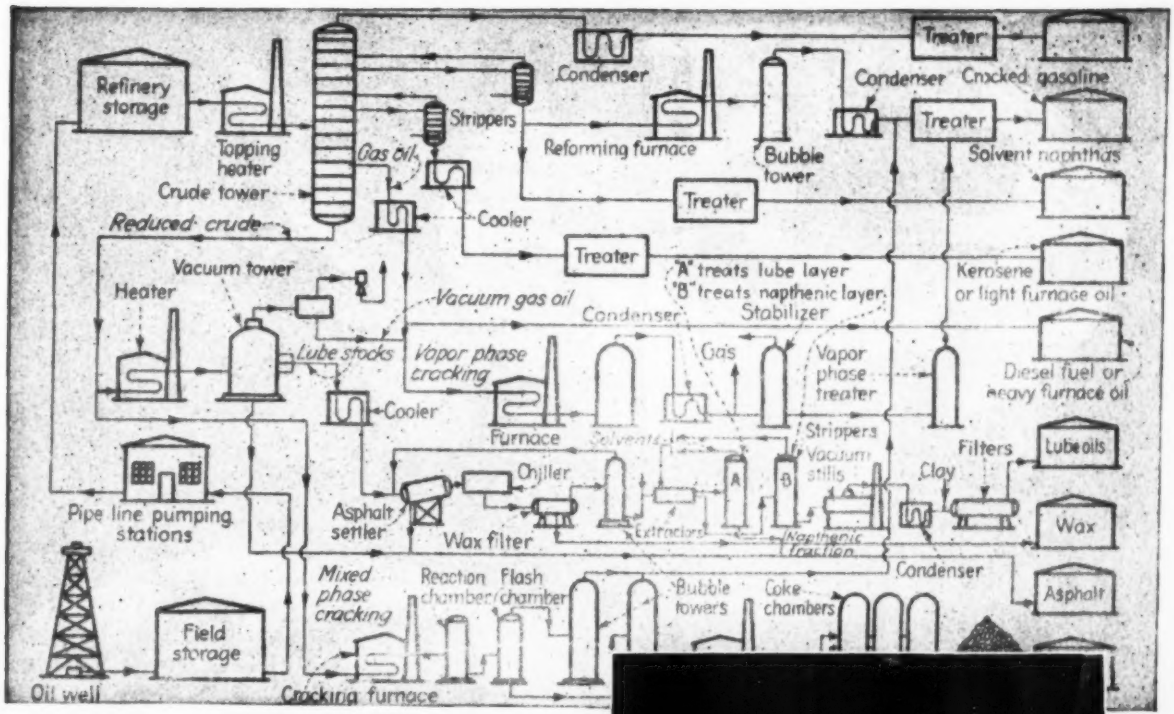
410 South Geddes St., Syracuse 1, N. Y.

Wherever FILTRATION enters your picture....



you're miles ahead with *Niagara*

Let's look at the facts.
A Niagara Style "H" Horizontal Pressure Leaf Filter will filter to clarity at rates up to 45,000 G.P.H. *That's efficiency.*
Flow rates are from two to five times those of old fashioned cloth covered presses. *That's speed.*
This unit can be drained, opened, cleaned, closed, filled and precoated . . . by one man . . . in a matter of minutes instead of hours. *That's time saving.*
Filter cake drops into a receptacle for immediate dry disposal. *That licks the stream-pollution problem.*
No cloths or pads are required. *That's genuine economy.*
Niagara Pressure Leaf Filters . . . both vertical and horizontal . . . are improving product quality, reducing filtration costs, and saving time in hundreds of plants all over the country. *And that's a fact.*

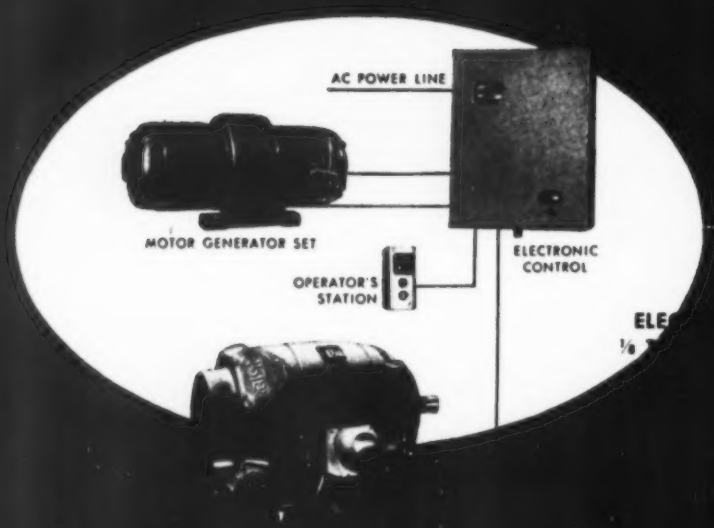
Niagara Filters
DIVISION
AMERICAN MACHINE AND METALS, INC.
EAST MOLINE, ILLINOIS
Niagara Filters Europe, Post Box 1109, Amsterdam-C, Holland

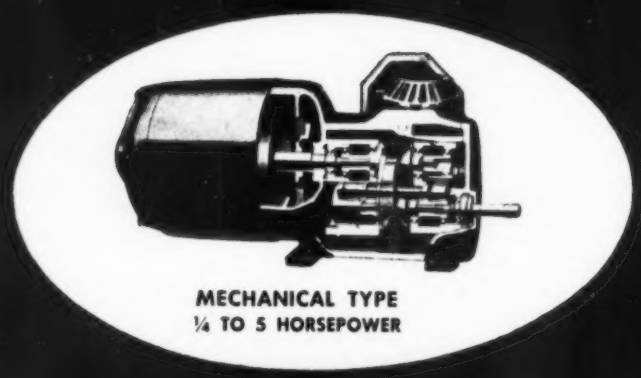
Niagara Pressure Leaf Filters are available in a wide range of capacities and can be made of stainless steel or special alloys for corrosion resistance. Want more facts? Just clip and mail the coupon . . . no obligation.

NIAGARA ENGINEERS ARE AT YOUR SERVICE. These practical filtration experts will study your problems . . . test your samples . . . work with your engineers . . . pilot the filtration . . . and then build a Niagara unit to meet your most exacting requirements.

Niagara Filters Division, American Machine and Metals, Inc.
Dept. PR454, East Moline, Illinois
YES . . . we'd like to know more about Niagara Pressure Leaf Filters for _____ (product or operation)
☐ Send catalog No. NC-1-53 ☐ Have representative call
Name_____
Title_____
Company_____
Address_____
City_____ Zone_____ State_____

For more data on advertised products, use Readers' Service Cards, last page.





MECHANICAL TYPE
¼ TO 5 HORSEPOWER

SPEEDRANGER

Need variable speed . . . come to MASTER, the only manufacturers of variable speed drives who can offer you a choice between the advantages of MECHANICAL variable speed and ELECTRONIC variable speed operation. And since both the mechanical and the electronic drives are available with any of MASTER'S five types of gear units, you can secure speed variation in either high speed or low speed ranges. Always check with MASTER for impartial help in selecting the drive that is right for you. **THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO**

consider but 2 basic factors . . .

. . . when you think of fire protection, the selection of the very best of mechanical devices and—the engineering of these devices into an automatic system which will provide the maximum protection against your specific hazard.

Both are important. The finest of both are to be had at Blaw-Knox.

Blaw-Knox Fog Systems, thermostatically controlled, instantly blanket all protected equipment with millions of cooling drops of water which extinguish the fire and quickly absorb heat. They sound alarms, confine damage and protect nearby equipment.

Carefully engineered into a fire protection system designed to guard against your specific hazard, Blaw-Knox Fog Nozzles provide the most effective means of protection known.

Let a Blaw-Knox Fire Protection Engineer study your needs, submit a preliminary layout and cost estimate . . . absolutely without obligation.

You'll be interested in the new Blaw-Knox booklet, "FIRE CAN DESTROY YOUR BUSINESS." Write for it.

BLAW-KNOX FIRE PROTECTION SYSTEMS CARRY APPROVALS OF ALL INSURANCE UNDERWRITERS. Deluge Systems • Wet Pipe Systems • Dry Pipe Systems • Water Spray and Fog Systems • Rate-of-Rise Sprinkler Systems • Foam and Carbon Dioxide Extinguisher Systems

"Little Joey Sprinkler" always on the job

BLAW-KNOX

BLAW-KNOX COMPANY

Automatic Sprinkler Department / Pittsburgh 33, Pennsylvania

For more data on advertised products, use Readers' Service Cards, last page.

15 YEAR FAVORITE

DEPENDABLE

RUGGED

EASY, LOW COST MAINTENANCE

SIMPLE ADJUSTMENTS

VERSATILE

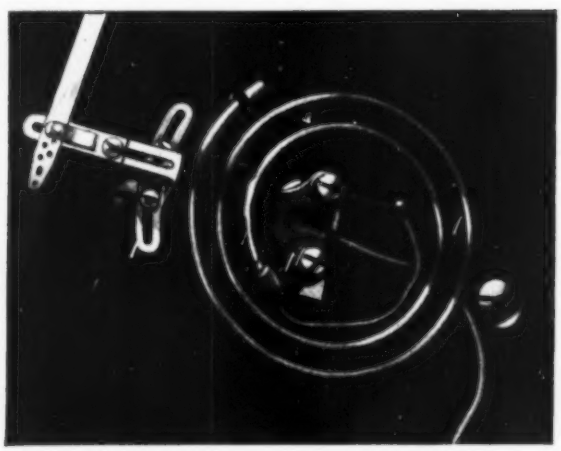
TROUBLE-FREE

SIMPLE OPERATION

LONG LIFE

Single Duty FULSCOPE Recording Controller with Adjustable Sensitivity, Automatic Reset and PRE-ACT responses. Double Duty control mechanisms, with *any* combination of control responses, afford a great advantage on many applications.

Sensitivity adjustment unit; single, continuous adjustment calibrated in specific units.



Improved sub-base permits easy, precise replacement of pre-calibrated actuating systems in field.

For more data on advertised products, use Readers' Service Cards, last page.

IN GASOLINE PLANTS

. . . the Taylor Fulscope® Controller

ITS dependability and accuracy have made the Taylor FULSCOPE Controller specially adaptable to the requirements of natural gasoline plants. Rugged, trouble-free, it can be relied upon to run for hours on end unattended and to give smooth, uninterrupted operation in the production of specification products. Thus the operators are freed for over-all plant supervision and other maintenance duties.

For the benefit of those who are new in positions of responsibility in the selection of instrumentation, here are some of the reasons why Taylor Series 100 FULSCOPE Controllers have been able to meet these exacting requirements and consequently reign supreme throughout industry.

ADAPTABILITY

1. Extremely versatile. The same control mechanisms are available for Temperature, Pressure, Flow and Liquid Level—in either recording or indicating models, as locally mounted controllers, transmitters or controlling receivers. Interchangeable unit construction permits a small inventory of parts. Pre-calibrated units eliminate expensive checking. Easy visibility and accessibility of components means an instrument man can have a unit back on the job with minimum down time.
2. Adaptable to any control problem because the FULSCOPE Controller has three control effects:

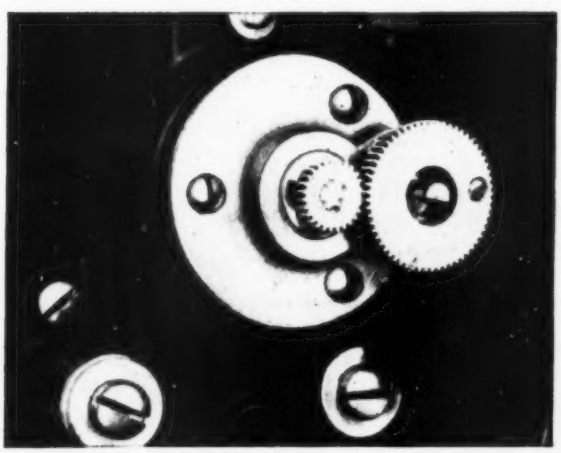
(a) Proportional Response—available in three forms: Fixed High Sensitivity (1000 psi per inch pen movement): Adjustable Sensitivity (1000 to 1 psi); and Limited Range Sensitivity (400 to 30 psi). **(b) Automatic Reset Response,** completely and continuously adjustable (.05 to 5 repeats per minute). **(c) PRE-ACT* Response** (rate action) continuously adjustable within the range of 0.2 to 10 mins. All the adjustments are wide range and continuous. Any combination of these control responses may be used to provide any required quality of control. PRE-ACT and reset units are interchangeable.
3. Proper Adjustment Easily Obtained. Control Response Adjustment Dials are calibrated in specific units, repeatable in all instruments. Optimum settings are quickly determined.
4. Controller action simply changed by lifting a spring clip and rotating set-point knob.

DEPENDABLE OPERATION

5. Control point always matches set point when automatic reset is used, thanks to fully pneumatic sensitivity reduction. Lowering sensitivity for stability does not reduce the effectiveness of the reset response. Result – control point always returns to set point, regardless of load changes.
6. Trouble-free air system. Metal disc type filters are built-in features, easily removed for cleaning. Both relay air valve and nozzle are made of 18-8 stainless steel. A simple system, made of corrosion resistant parts, easily accessable for cleaning.
7. Lifelong Accuracy. Fewer links and pivots. Dead spot and hysteresis practically non-existent due to lightweight stainless steel link and small diameter burnished pivots. This lightweight construction nullifies vibration effects. Spring pivot clips, which do not gum up or corrode, replace screws. Over and under-range linkage protection provided when required.

Whether your processing problems are simple or complex, there's a Taylor instrument or control system and a competent Taylor Field Engineer ready to help you solve them.

Write for Bulletin 98151. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.



Interchangeable needle valves in Automatic Reset and PRE-ACT units.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

*Trade-Mark

Taylor Instruments
MEAN ACCURACY FIRST

For more data on advertised products, use Readers' Service Cards, last page.

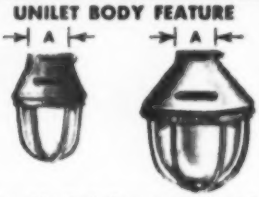
Relamp or Convert to Higher Wattages in **SECONDS...**

with

APPLETON

vented Explosion-Proof Fixtures

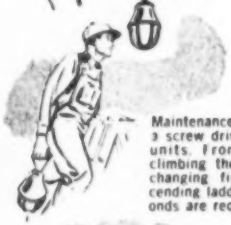
APPLETON INTERCHANGEABLE UNILET BODY FEATURE



Note how identical diameters "A" at top of Dome Unit Assembly permit mounting of all fixtures regardless of wattage.

58 SECOND RELAMPING

When the call comes for relamping, AA-51 Series STAND-BY Units are ready at an instant's notice. Carrying handles can be attached in advance.



Maintenance man needs only a screw driver to exchange units. From the time of climbing the ladder to exchanging fixture and descending ladder, only 58 seconds are required.

Burned out lamps and cleaning fixture are safely attended to at the work bench, while production schedules are maintained.

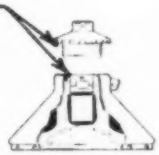
Standardized Unilet Body Permits 58 Second Interchange of 60 Watt to 500 Watt Fixtures . . . Saves Time, Prevents Shutdowns! *Appleton* AA-51 Series Vented Explosion-Proof Fixtures offer the most complete protection available today against spark-caused disaster . . . plus the shortest possible lamp exchange time regardless of individual lamp wattage, with no loss of man-hours and no lengthy machinery shutdowns.

The AA-51 Series meets all Underwriters' Laboratories requirements for Class I, Groups *C* and *D* Hazardous Locations.

More and more plants in the petroleum industry are standardizing on *Appleton* for maximum, efficient protection in hazardous areas. Full details are available. Write Today for Bulletin!

- **"FLAME-TIGHT" CONTACT CHAMBER**

  Because of *Appleton's* exclusive "5-Thread Safety Chamber" any AA-51 Series Unit can be serviced with complete safety even if current is inadvertently left on!



- **"FULL-CIRCLE" VENTING**

  The notched globe ring and the porous metal interior dissipate heat evenly and safely and keep fixture temperature cool enough to prevent igniting explosive gases.

- **"STAND-BY" SYSTEM SAVES MONEY**

  For every ten AA-51 Units in operation *Appleton* recommends one unit as a stand-by . . . ready for relamping or wattage conversion in 58 seconds.

SOLD THROUGH ELECTRICAL WHOLESALERS

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1732 Wellington Avenue • Chicago 13, Illinois

APPLETON ELECTRIC PRODUCTS — REG. U.S. PAT. OFF.

Also Manufacturers of:

Malleable Iron Unilet Fittings

Industrial Lights

"ST" Series Connectors

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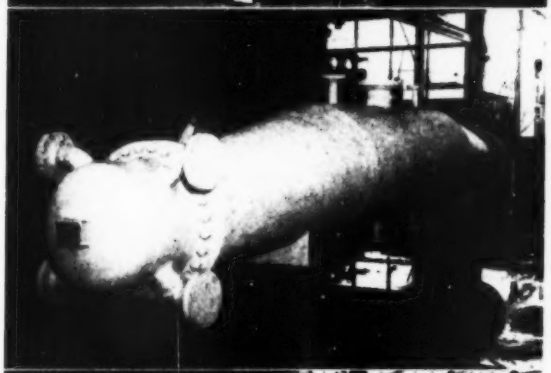
HEAT EXCHANGERS



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PETROLEUM and CHEMICAL Industries

Performance engineered to fit YOUR heat transfer needs.

DESIGN
REPAIR
FABRICATION

Your inquiries are cordially invited.

TEXAS METAL FABRICATING COMPANY

HOUSTON

Wagner®
TRANSFORMERS
... the choice of leaders in industry

CHOOSE WAGNER UNIT SUBSTATION TRANSFORMERS

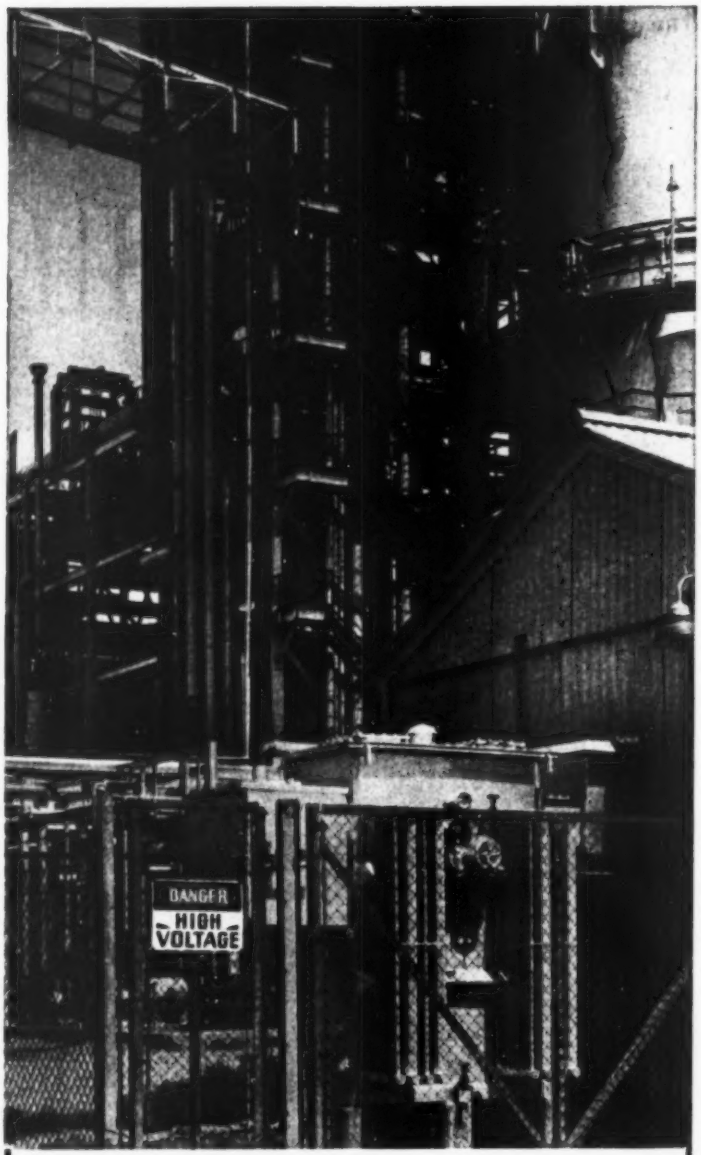
for always dependable power...

Here's dependability at work! This Wagner liquid-filled unit Substation Transformer feeds the catalytic unit at The Carter Oil Company refinery in Billings, Montana.

You'll find hundreds of Wagner Transformers, furnishing *always dependable* power, in spots where failure would incur great cost, because Wagner Transformers are known for their unfailing dependability—a reputation backed by more than sixty years of transformer building experience.

Wagner Unit Substation Transformers, both liquid-filled and dry-type, are carefully designed to meet distribution requirements. Both liquid-filled and dry-type unit substation transformers are built in ratings through 2000 kva, 15 kv and below—you can choose the type and rating that exactly meets your load-center distribution requirements.

Bulletins TU-13 and TU-56 give full information. Your nearby Wagner engineer can help you solve your load-center problems. Call the nearest of our 32 branch offices, or write us.



This 750 kva, 2400/4160Y to 480 volt, 60 cycle, three-phase, liquid-filled Wagner Unit Substation Transformer feeds the catalytic unit at The Carter Oil Company, Billings, Montana refinery. It is throat connected to switchgear in the adjoining building. Purchased and installed by The Fluor Corporation, Ltd., Engineers and Constructors for the Petroleum, Chemical and Power Industries, Los Angeles.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6458 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

754-3

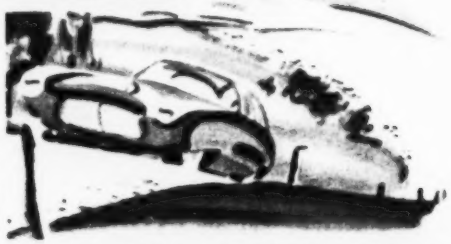
Crude oil is piped to the Sarpom Refinery at San Martino di Trecate, Italy, from Savona on the Mediterranean.

ITALY'S NEW LOOK

The basic design of the "Sarpom" refinery, recently completed on the plains of Northern Italy, is the work of Stone & Webster Engineering Corporation, with detailed engineering, procurement and construction management by its affiliate, E. B. Badger & Sons Limited.

The refinery, having a capacity of 15,000 barrels per day, consists of crude distillation, reforming, treating and general facilities. Catalytic cracking and polymerization units are now being added.

These facilities for Societa per Azioni Raffineria Padana Olii Minerali, a Caltex-Fiat subsidiary, are among eighty new refinery units recently executed by our Badger Process Division.



Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Toronto

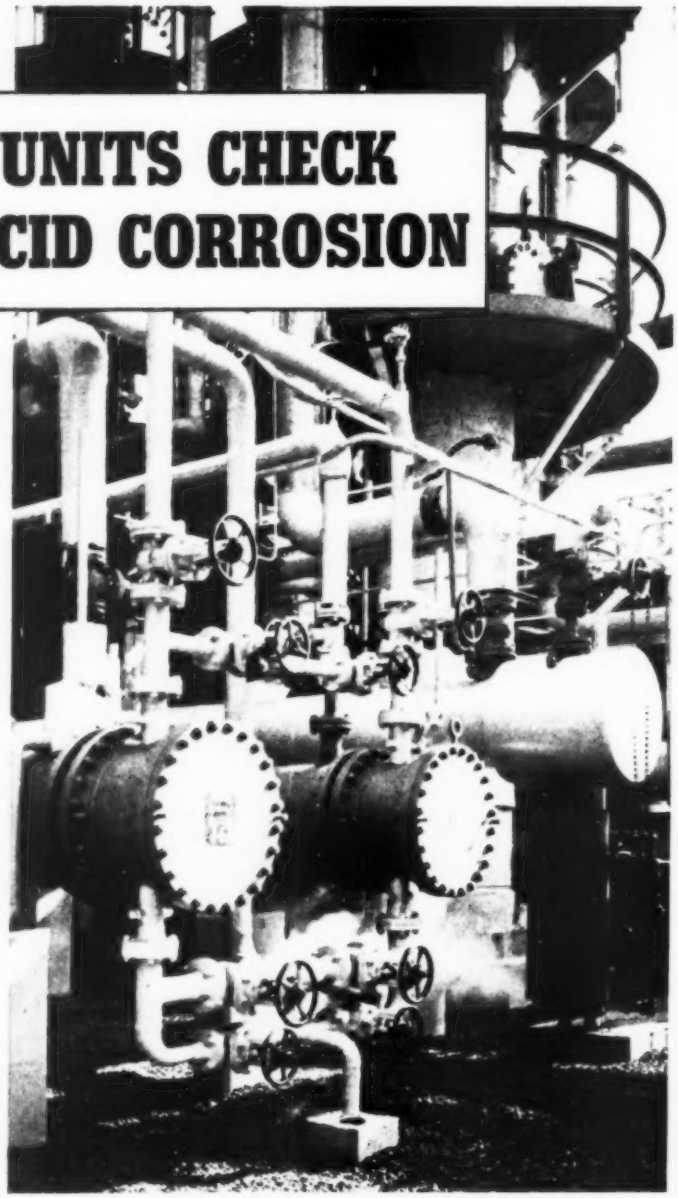
CLAD STEEL UNITS CHECK NAPHTHENIC ACID CORROSION

Corrosion is a constant threat in these naphthenic acid recovery units at a leading eastern refinery. Preheaters handle a mixture of the naphthenic acids, dissolved in a solvent of naphtha and isopropyl alcohol containing sulphuric acid, heating it to 350° F. After stripping, the naphthenic acid distillates—still corrosive—are cooled in a special acid cooler. Operation must be continuous, corrosion protection certain.

Economical stainless clad steel—in the tube sheets, floating head covers, channels and channel covers—stands up to this 24-hour-a-day operation and shrugs off corrosion. A layer of stainless steel—integrally and permanently bonded to a low-cost carbon-steel backing plate—gives all the benefits of the more expensive solid alloy. There is no danger of seepage or crevice corrosion . . . and the chance of equipment failure causing unscheduled shutdowns is greatly reduced.

But economical resistance to corrosion is not the only benefit clad steel equipment offers. The combined teamwork of sound engineering and modern fabricating techniques can take full advantage of the versatility of clad steels. You can look for tanks and pressure vessels that minimize first cost and assure long, trouble-free life . . . give maximum capacity in the least space . . . withstand high pressures and temperatures . . . resist thermal shock . . . permit easy and economical field erection.

You can profit by consulting your fabricators about clad steel's advantages *early* in your planning. Their close teamwork with your engineers and consultants will help give you equipment tailored to your exact processing needs.



Stainless-clad steel provides economical resistance to extreme corrosion in these acid stripping and cooling units.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 681 Lukens Building, Coatesville, Pennsylvania.

LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

Keep Heat Transfer Surfaces CLEAN...

SPECIFY

Vogt

SCRAPED SURFACE *Exchangers*

IF you are all "gummed up" with a tough heat transfer problem, Vogt Scraped Surface Exchangers will provide the answer. They have patented scraper elements which prevent fouling of the heat transfer surfaces and insure the highest rate of heat exchange between the product and the cooling or heating medium. The scrapers also continuously agitate the fluid and assist removal of solids from the unit.

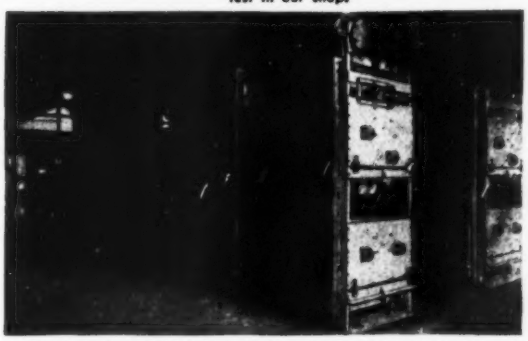
DOUBLE PIPE EQUIPMENT is available in two types; EXCHANGERS, for cooling with water, brine, and cold filtrate, and for heating with steam or hot liquids; and CHILLERS, for use with volatile refrigerants such as ammonia, propane, and Freon. Both types have 8" jacket pipes and 6" inner pipes with scrapers.

SHELL AND PIPE TYPE UNITS are designed for use with volatile refrigerants and for heating fluids with steam or similar heating mediums. They consist of large welded shells each containing seven 6" scraped pipe sections.

Vogt Scraped Surface Exchangers serve profitably as oil chillers, crystallizers, and heaters in many processes in the petroleum and chemical industries. Their application to your heat transfer problems will receive the prompt attention of our Engineering staff.

Write for Bulletin PE-1

*DOUBLE PIPE UNIT. Drive and close-up of 12 section unit under test in our shop.



*SHELL and PIPE UNITS. Two of five units installed in a leading petroleum refinery.

*Patented

HENRY VOGT MACHINE CO.

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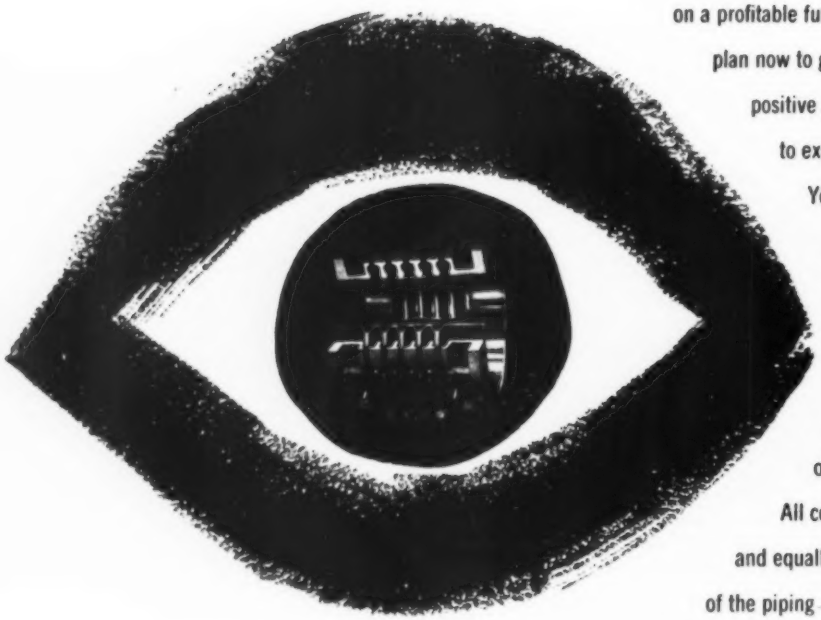


If you've got your eye
on a profitable future,
plan now to give
positive protection
to expensive piping and equipment.
You'll avoid costly failure
due to expansion or contraction
by specifying Zallea
Duo-Equalizing Expansion Joints.
These joints are designed
to eliminate unequal distribution
of movement among the corrugations.
All corrugations move simultaneously
and equally during expansion or contraction
of the piping – and no corrugation
can be compressed or extended
more than the proportional amount
for which it is designed.

Zallea already has, or will make, expansion joints for every service. For information on standard types, request Bulletin 351. For consultation on special problems, ask us to have our representative call.

Zallea *expansion joints*

ZALLEA BROTHERS, 890 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints

New

. . . and designed *Specifically* for the PETROLEUM, CHEMICAL, PETRO-CHEMICAL and ALLIED INDUSTRIES

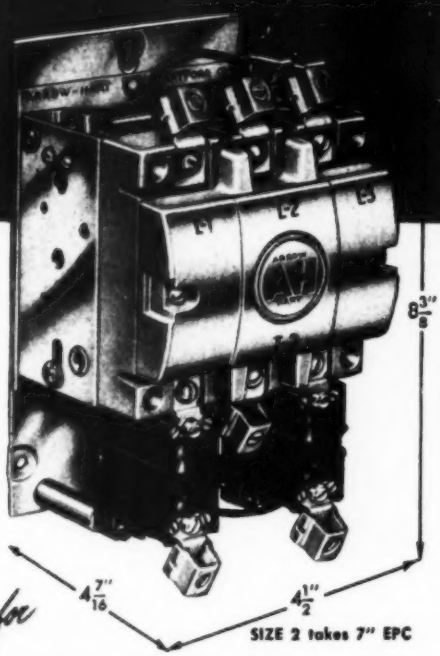
ARROW AH HART

TYPE "RA-V"

Magnetic

MOTOR STARTERS

VERTICAL OVERLOADS



for SIZE 2 takes 7" EPC

for use with the NEW CROUSE-HINDS M52 TYPE EPC EXPLOSION-PROOF CONDULET

SMALLER SIZE and LIGHTER WEIGHT Plus ADDED DEPENDABILITY

Like all other motor controls in the Arrow-Hart "RA" Line, the Type "RA-V", also makes use of the outstanding "Right Angle" Operating Mechanism. This exclusive Arrow-Hart feature, a revolutionary concept in motor control design, makes it possible to build superior performance and dependability and many other operating advantages into a starter radically smaller and lighter than any other control of equal rating.

For example . . . the A-H Type "RA-V" is the **only** Size 5 starter manufactured anywhere that can be housed in an EPC Condulet. The Type "RA-V" Size 2 requires only a 7" Condulet; "RA-V" Size 3 a 9" Condulet —instead of the 9" and 11" Condulets respectively required by all other Size 2 and 3 starters. The Arrow-Hart Size 4, as installed in an 11" Condulet, is our standard, full-sized starter offering full capacity, peak performance, and complete dependability . . . it is not an uprated Size 3 or other made-to-do adaptation. Here are important savings all down the line . . . in initial and installation costs, in smaller lighter mounting racks required and in lower building costs where control equipment is installed indoors.

- **SMALLER, LOWER-COST CONDULETS**
- **FASTER, EASIER INSTALLATION**
- **REDUCED SIZE and COST OF MOUNTING RACKS**
- **SPACE SAVINGS, LOWER BUILDING COSTS**

DON'T TAKE OUR WORD FOR IT . . .

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ARROW-HART INDUSTRIAL CONTROL DIVISION
THE ARROW-HART & HEGEMAN ELECTRIC COMPANY
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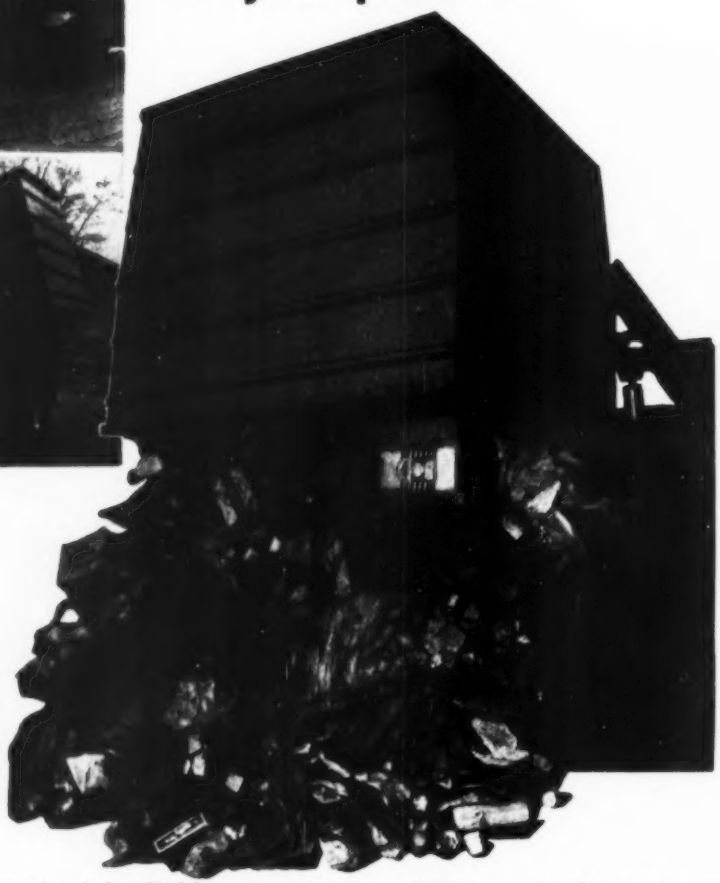
Rubbish Disposal is only ONE of the Cost Cutting jobs for the Dempster-Dumpster in your plant...



It's amazing, almost to the point of fantasy, yet so soundly real, what the minds of men in all types of industry have cooked up for more efficiency and reduced costs with the Dempster-Dumpster.

Hundreds of plants are handling materials of practically every description with one truck-mounted Dempster-Dumpster serving scores of detachable containers. Here are just a few. Oils, gases, and liquids handled in our Tank Type Containers . . . tools and equipment in our Tool Shed Type Container . . . containers on casters placed for receiving steel chips from lathes or at conveyors for receiving finished products . . . container with doors and windows, replacing shacks for plant guards or nightwatchmen . . . containers built to handle chlorinator ash residue of approximately 1500° F. and there are dozens more.

Containers are placed wherever material accumulates. When loaded each is picked-up, hauled and emptied (as illustrated above) . . . or load set down intact. The entire operation is handled by only one man, the driver, by hydraulic controls in cab.

The containers are built in capacities up to 12 cu. yds. and each is designed to suit the materials to be handled—be they bulky, light or heavy . . . solids, liquids or dust.

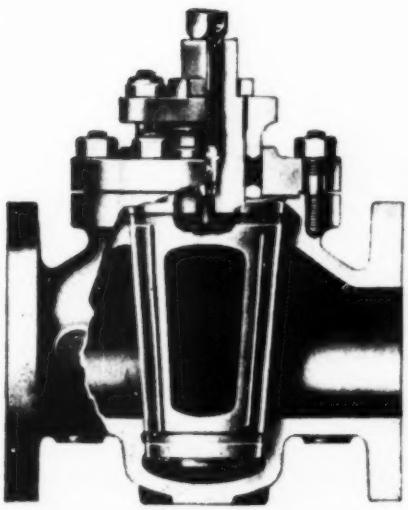
One Dempster-Dumpster, with driver, does the work of 3 to 5 conventional trucks . . . eliminates trucks and crews standing idle . . . eliminates rehandling of materials and increases efficiency and good plantkeeping.

If you have even any remote idea that this equipment could be adapted to your operation, by all means contact us because being without the Dempster-Dumpster System could easily be costing your company thousands of dollars annually. Manufactured and sold exclusively by Dempster Brothers, Inc.

One Dempster-Dumpster Handles All Containers . . . . All Sizes . . . . All Designs

DEMPSTER BROTHERS, 544 Dempster Bldg., Knoxville 17, Tennessee

WALWORTH
Lubricated
Plug Valves



for TOUGH assignments

where tight shut-off...
and easy operation
are "MUSTS"

Walworth Lubricated Plug Valves Offer These Advantages

- Complete surrounding of ports with resistant lubricant affords positive seal against leakage.
- Lubricant grooving system assures ease of operation — tight shut-off — greater protection against corrosion.
- Body and plug fully protected by lubricant from attack by line fluids.
- Quarter turn opens or closes valve.
- Made in a complete range of sizes ½" to 26" and for pressures from 175 to 5,000 psi., and for vacuum requirements.

For handling petroleum products, natural or manufactured gas, acids, alkalies, solvents, slimes, slurries . . . in fact for almost any hard-to-handle liquids—there's a Walworth Lubricated Plug Valve designed for the job.

Easy to operate, tight sealing, resistant to wear and corrosion, Walworth Lubricated Plug Valves assure long years of dependable service at low operating cost.

Walworth Lubricated Plug Valves are available in sizes ½" to 26" for pressures from 175 to 5,000 psi., and for vacuum requirements. For full details—prices, sizes, dimensions, and other pertinent data, see your Walworth distributor or write to:

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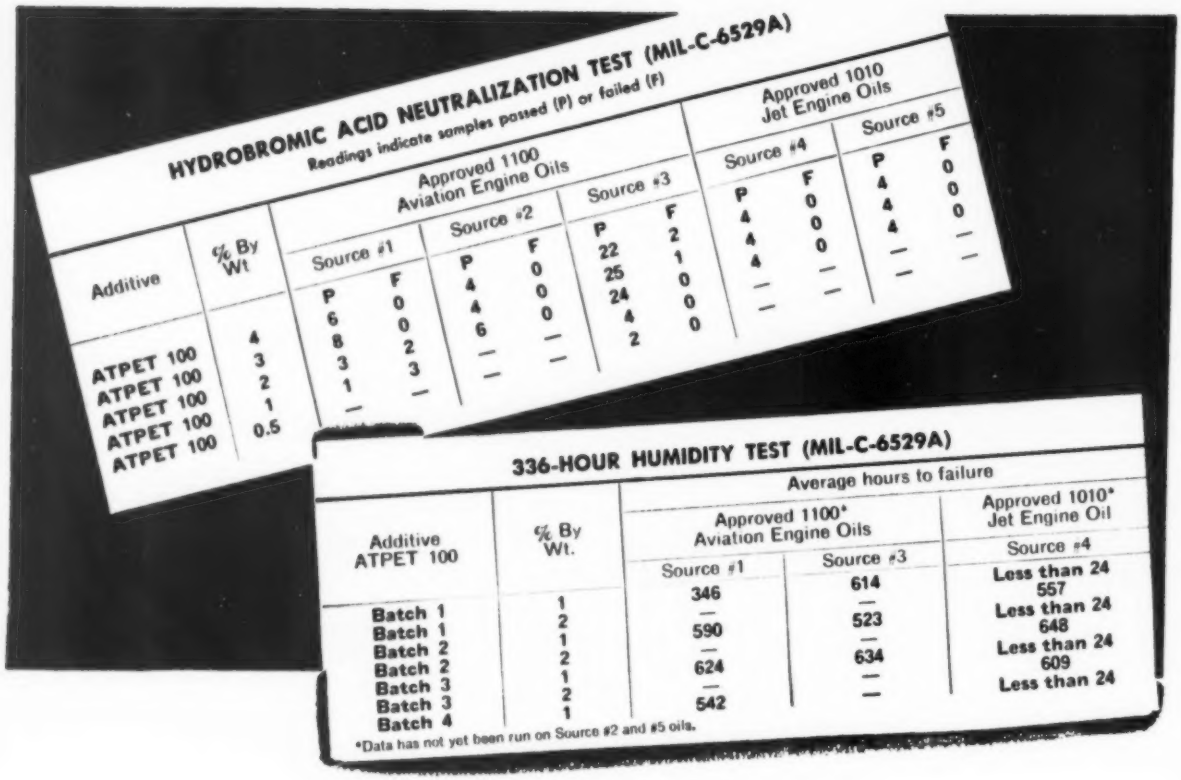

HYDROBROMIC ACID NEUTRALIZATION TEST (MIL-C-6529A)

Readings indicate samples passed (P) or failed (F)

Additive	% By Wt	Approved 1100 Aviation Engine Oils						Approved 1010 Jet Engine Oils			
		Source #1		Source #2		Source #3		Source #4		Source #5	
		P	F	P	F	P	F	P	F	P	F
ATPET 100	4	6	0	4	0	22	2	4	0	4	0
ATPET 100	3	8	2	4	0	25	1	4	0	4	0
ATPET 100	2	3	3	6	—	24	0	4	—	—	—
ATPET 100	1	1	—	—	—	4	0	—	—	—	—
ATPET 100	0.5	—		—	—	2		—	—	—	—

336-HOUR HUMIDITY TEST (MIL-C-6529A)

Additive ATPET 100	% By Wt.	Average hours to failure		
		Approved 1100* Aviation Engine Oils		Approved 1010* Jet Engine Oil
		Source #1	Source #3	Source #4
Batch 1	1	346	614	Less than 24
Batch 1	2	—	—	557
Batch 2	1	590	523	Less than 24
Batch 2	2	—	—	648
Batch 3	1	624	634	Less than 24
Batch 3	2	—	—	609
Batch 4	1	542		Less than 24

*Data has not yet been run on Source #2 and #5 oils.

ATPET 100

proves a superior rust inhibitor

Here's the corrosion inhibitor you've been looking for. It's ATPET 100, the new non-metallic rust preventive developed by Atlas for use in slushing oils, engine preservatives and other corrosion-preventive compounds.

Its effectiveness in protecting metal surfaces is proved by tests conducted in the Atlas laboratories, results of which are tabulated above. Compare this performance against that of any other inhibitor—and you'll see that ATPET 100 gives better protection even when used in small concentrations.

What's more, the quality of ATPET 100 stays completely uniform from shipment to shipment. And its price compares with metallics. Write today for test samples—and for full information on this economical, highly efficient oil additive.

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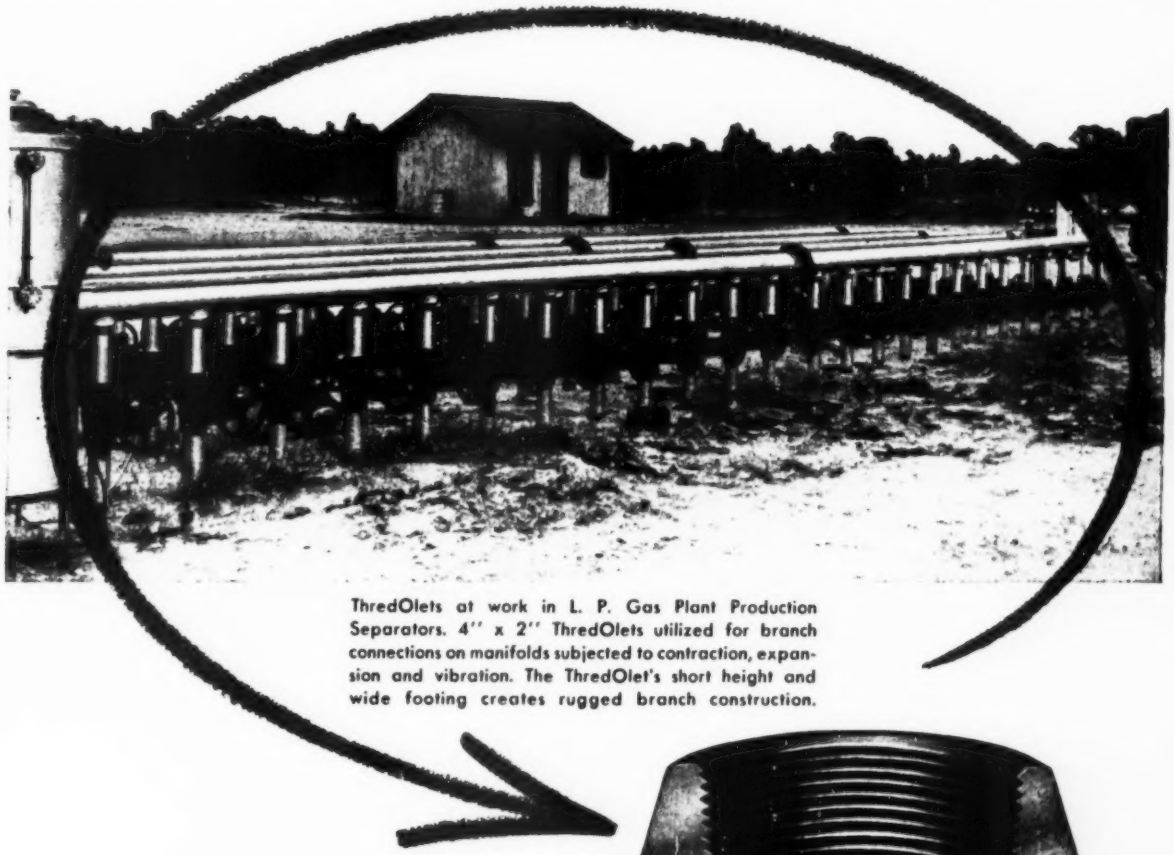
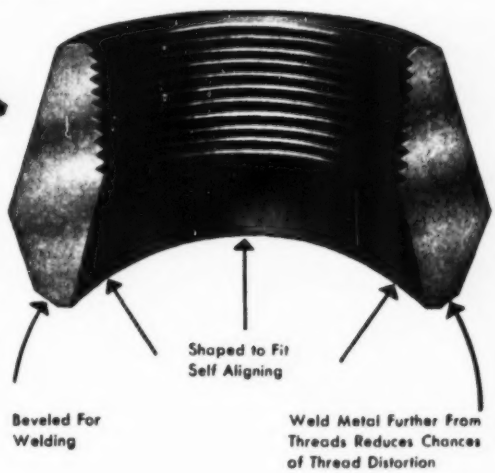
BOOST YOUR PRODUCTION with THREDOLETS and SOCKET WELDOLETS!



ThredOlets at work in L. P. Gas Plant Production Separators. 4" x 2" ThredOlets utilized for branch connections on manifolds subjected to contraction, expansion and vibration. The ThredOlet's short height and wide footing creates rugged branch construction.



Insure production economy in pipe fabrication through the *exclusive* features *engineered* and *manufactured into* ThredOlets and Socket WeldOlets. Production is boosted because you weld *more pieces* per hour!

Instant application and immediate availability will save you time, labor and money in constructing all 90° Threaded and Socket-weld branch connections.

SPECIFY AND USE...
BONNEY THREDOLETS & SOCKET WELDOLETS

FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W-3 WELDOLET CATALOG
DISTRIBUTORS IN PRINCIPAL CITIES

ThredOlets

Socket WeldOlets

For more data on advertised products, use Readers' Service Cards, last page

Fractions
SOLVE BIG PROBLEMS

The petroleum industry has made good use of the "divide-and-rule" formula that conquered kingdoms . . . to win command of the giant powers hidden in nature's oil. The industry's process engineers have transformed American life by their mastery of petroleum's secrets . . . and fractionating has been their master key.

These engineers' ability to develop processes which break petroleum into its component fractions has harnessed the "black gold" into a myriad forms of service. There have been other important results, too. The gigantic motor industry . . . America's vast network of modern highways . . . the services to motor travel—these are largely by-products of the petroleum process engineer's knowledge of fractional distillation.

For many years, Sun Ship has been adding to its own prestige by the service and cooperation its great shops give to the petroleum industry, and to the many other industries which call on Sun Ship's versatile engineering and construction skills. It has built . . . for chemical and petroleum process engineers, and for refineries throughout the world . . . the immense fractionating towers, pressure vessels, special machinery and heavy equipment they require. The 95'7" crude tower shown in the photograph, ready for shipment, is a representative example.

Sun Ship's services will continue to keep pace with the giant strides made by the nation's industries in the engineering progress which is steadily building a greater America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE SINCE 1916 CHESTER, PA.

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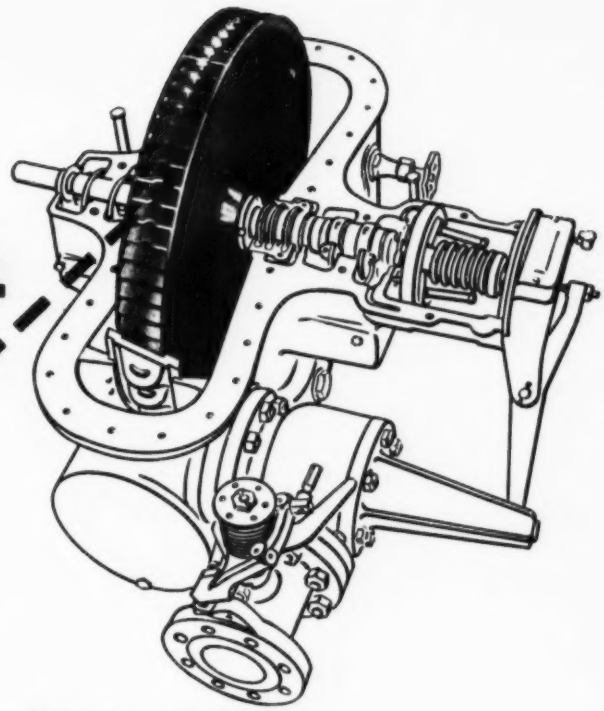
TERRY SOLID WHEEL



..."trade mark" of a trouble-free turbine

This is the rotor of a Terry solid-wheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semi-circular buckets is milled, there are no separate parts to become loose or work out.

Second, because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets, blade wear is of little consequence. Wear does not materially affect horsepower or efficiency.

Third, because the steam enters the buckets in a direction at right angles to the shaft, there is no need for close axial blade clearances. The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, the blades are double rim protected.

These are only a few of the reasons why the Terry solid wheel has become a "Trade Mark" for trouble-free turbine performance. For complete details, send for a copy of bulletin S-116. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1197

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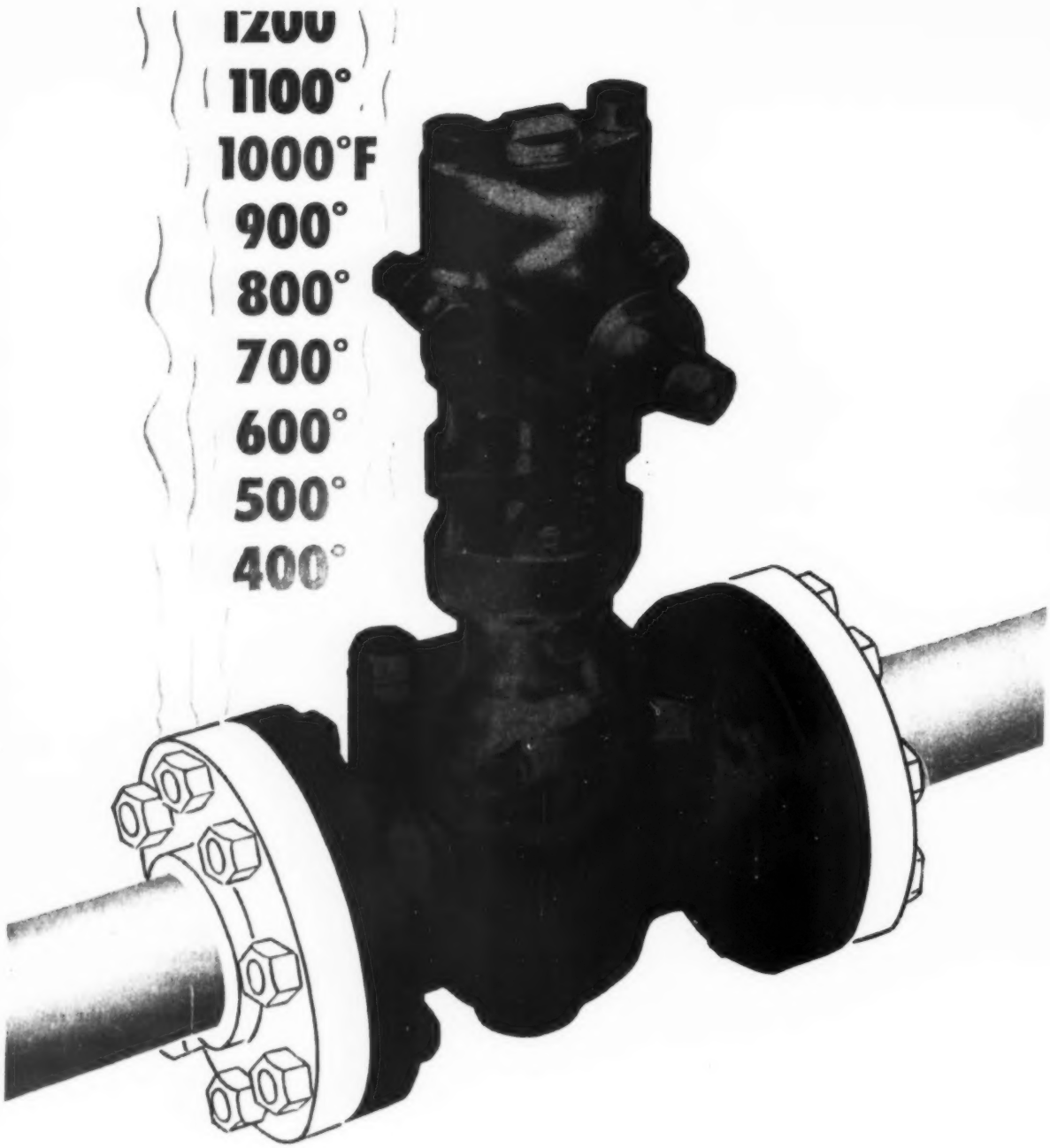

Cameron

Lift-Plug Valves are ideal for high temperature service. They require no lubrication to effect a seal. They require no lubrication for easy operation. Their advanced design employs a seat which is separate from and not attached to the body, is not affected by body distortions resulting from elevated temperatures or line pressures.

The standard Cameron High-Temperature Valve is recommended for temperatures ranging up to 1000° F. Using special materials, these valves are performing satisfactorily at 1600° F.

Cameron

IRON WORKS, INC.
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47%
or
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Saved.... IN PREMIUMS

What POLICYHOLDERS *Say*

This is one of many testimonial letters received from policyholders of the Texas Employers Insurance Association.

Ask the Texas Employers representative nearest you to show you more of these letters, as proof of what Texas' largest writer of Workmen's Compensation Insurance can do for you.

40TH ANNIVERSARY

WE QUOTE FROM A POLICYHOLDER'S LETTER:

"We wish to acknowledge the receipt of your dividend check in the amount of $7,178.57 which was recently delivered to us by your representative. This check along with the Guaranteed Cost Discount of $2,251.50 makes a total saving on the Standard Premium of $9,430.07 or 47.69% of the total Workmen's Compensation Premium paid by us for the period 1-1-52 to 2-1-53.

"We feel that this saving was brought about by the interest of our management and employees in accident prevention work and the cooperation and service rendered by your sales, engineering and claims departments."

Largest Writer of WORKMEN'S COMPENSATION INSURANCE *in Texas*

HOMER R. MITCHELL, *Chairman of the Board* A. F. ALLEN, *President*

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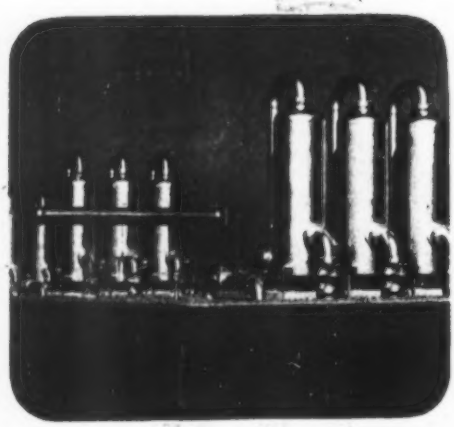
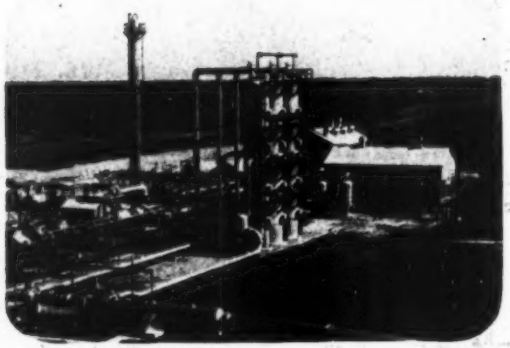
DRESSER engineering COMPANY

Since 1926 . . .





We specialize in handling complete projects from inception; including evaluation of processes, engineering design, purchasing and complete construction ready for operation.

DRESSER ENGINEERING COMPANY

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P. O. Box 2518

L. L. Dresser, Pres. **Phone 4-2411**

The Mail Box . . .

Closely Followed

To The Editor:

We have just finished preparing a paper to be presented at the Annual Meeting of Western Petroleum Refiners Association. In writing it we followed very closely the procedure given in the pamphlet "How Petroleum Articles are Selected and Should be Written," which was published in November, 1952. We are all very enthusiastic about material contained in this booklet and we would like to know if it is possible to obtain additional copies of it. If so, what are the charges for two dozen copies? We would be pleased to hear from you at your earliest convenience.

Kenny Seed
Perco Division
Phillips Petroleum Company
Bartlesville, Okla.

Editor's Note—Yes, copies are available. And gratis, too.

It will interest you to know that dozens of companies have been asking for this helpful little booklet. Such distribution is exactly what we had hoped for when the editors got together some months ago and compiled the information. And it's going to result in better articles if the principles are followed. That, of course, will benefit us all.

School Uses Reprint

To The Editor:

We have in the past used very successfully one of your reprints in our Petroleum Refining School class. Unfortunately, our supply has been depleted. Will you kindly send at your earliest convenience, ten copies of "Cylindrical Furnaces for the Petroleum Industry" by O. F. Campbell, Sinclair Refining Company, East Chicago, Ind. It was reprinted from the PETROLEUM REFINER, January, 1950 issue. Thank you kindly for your cooperation.

W. E. Allen, Supervisor
Petroleum Refining School
The Atlantic Refining Company
Philadelphia.

'Quality, Understandability'

Dear Editor:

As a recent subscriber to your magazine I was not too familiar with the type of articles you carried but I would like to take this opportunity to congratulate PETROLEUM REFINER on both the quality and understandability of the articles it publishes.

J. T. Meenan, Engineer
American District Steam Co., Inc.
New York 17.

Three Reasons for PR

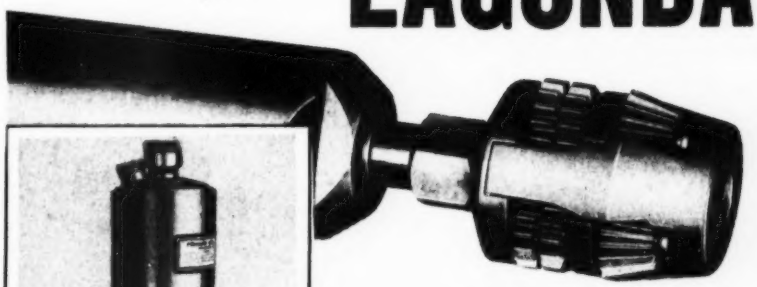
To The Editor:

. . . "Petrochemical Reactions" by Hatch is an excellent series. I enjoy reading PETROLEUM REFINER more than any of the other industrial or technical magazines because of the practical, informative and very well written articles.

James W. Bartley
355 1st Ave.,
Joliet, Ill.

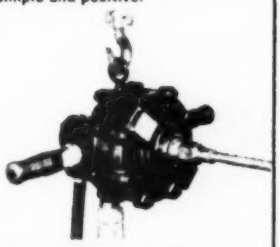
When Operators growl

...TRY LAGONDA



The famous Lagonda 1100 Series refinery cleaner, with the Type UO head. This combination is tough on coke.

AUTOMATIC SIGHT FEED LUBRICATOR controlled entirely by pressure. Simple and positive.



FOR CONDENSER AND HEAT EXCHANGER TUBES. Direct-drive air driven cleaner with long shaft, the motor supported outside the tube by overhead pipe. Motor has trigger control. Also available with electric motor.

CATALYST CLEANER. Removes spent catalyst from tubes, without permitting its escape.

Tube cleaning is a trying chore. You can't blame operators for getting sore at tools that make an uphill job of it, particularly if breakage occurs too often. Nor can you blame operators for trying, when a variety of tools are available, to get the Lagonda cleaner for their personal use. Sometimes an operator will "bunk" his Lagonda cleaner over the lunch-hour, making sure he'll get it again to finish the job. Just about the strongest recommendation a tool could have. To keep operators happy, and get stills back on stream quick, try Lagonda. Check with your nearby Lagonda man before your next cleanout. He can save you valuable time. Or write Elliott Company, Lagonda Division, Springfield, Ohio to put you in touch.

ELLIOTT Company

Y4-4

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

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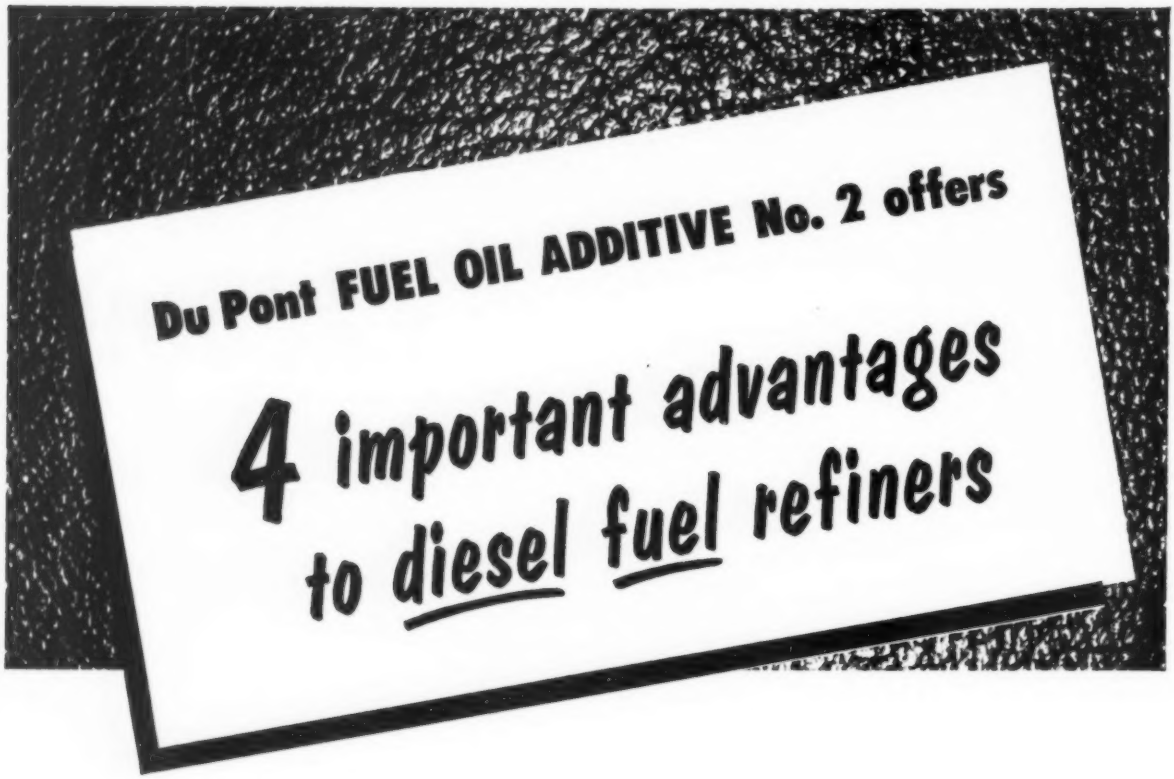

1. Leaves no deposits

Being ashless, Du Pont Fuel Oil Additive No. 2 leaves no combustion chamber deposits to cause operating difficulties.

2. Gives added flexibility

To help you gain added flexibility and capacity in diesel fuel production, Fuel Oil Additive No. 2 enables you to blend cat-cracked and straight-run stocks, without sacrificing stability in the blend.

3. Upgrades heavy oils

This additive can help you upgrade your heavy distillate fuel oils because it allows a certain amount of these heavy oils to be blended in the diesel fuel without affecting filterability.

4. Prevents clogging

Du Pont Fuel Oil Additive No. 2 not only retards the formation of insoluble residues, but also reduces the particle size of those insoluble residues that are formed and thus reduces clogging of diesel filter screens. Highly concentrated, Fuel Oil Additive No. 2 will produce desired results at the lowest possible cost.

Storage tests show that in all cases this additive—originally developed as a stabilizer and dispersant for distillate heating oils—gives best results when added at the refinery to freshly prepared stocks.

Free samples and more detailed information on Fuel Oil Additive No. 2 are available from any Du Pont Petroleum Chemicals Division representative or regional office.

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The LOOK BOX for April . . .

High Prices, Less Service

APPARENTLY resentment is mounting toward the practice of granting exclusive marketing rights for gasoline and related products sold on toll roads. Such exclusive rights have already been granted on several of the largest of the toll roads now operating. Dissatisfaction arises because the motorist is faced with a long wait in many instances because of the limited number of stations available. When his turn finally arrives, he is forced to pay prices several cents per gallon higher on gasoline than he would normally pay in the same state.

According to a recent issue of *Our Sun*, a publication of Sun Oil Company, 701 miles of toll roads are being used today and an estimated 840 miles of toll roads will be completed this year. This magazine also reports that the net result of these two factors has been that gasoline consumption at stations on two of the largest toll roads has been about half the amount estimated prior to road completion in spite of greater traffic than was anticipated. In addition, the percentage of service calls for motorists who are out of gasoline on these roads is more than five times the national average for such calls.

It is certainly not an original statement, of course, but it seems that there is nothing like good old competition to keep prices in line and to improve service. The management of toll roads might do well to take a good, long look at this situation of higher prices and less service.

Too Much Capacity?

AMID TALKS of too much refining capacity and high inventories, C. S. Teitsworth, Socony-Vacuum, brought up some pertinent points of history that the industry might well recall. Said Teitsworth: "Historically, the industry ran its refineries at 75 to 80 percent of capacity. We believe refinery runs for 1954 will be around 87 or 88 percent average for the year. This rate is altogether normal and although there may be some 13 percent unused capacity, such a situation is entirely in keeping with history, simply meaning that the industry is a little ahead of the actual current demand. The industry cannot afford to be without a fairly substantial peace-time cushion of this kind."

He also pointed to a similar situation in regard to excess crude oil producing capacity. Just before the war, there had been built up in the U. S. an excess producibility of about a million barrels per day. It has been estimated that excess producibility in the U. S. is currently in the neighborhood of that same figure. However, the excess capacity we now enjoy is considerably less in proportion to the current demand than a million barrels was in 1940 and it should have considerably less economic effect on the industry. From the standpoint of national interest this peacetime cushion is highly desirable and also in keeping with the history of the industry.

British Taught To 'Muck In'

U. S. OIL FIRMS who believe their methods are best received some effusive support last month from a traditionally staid source.

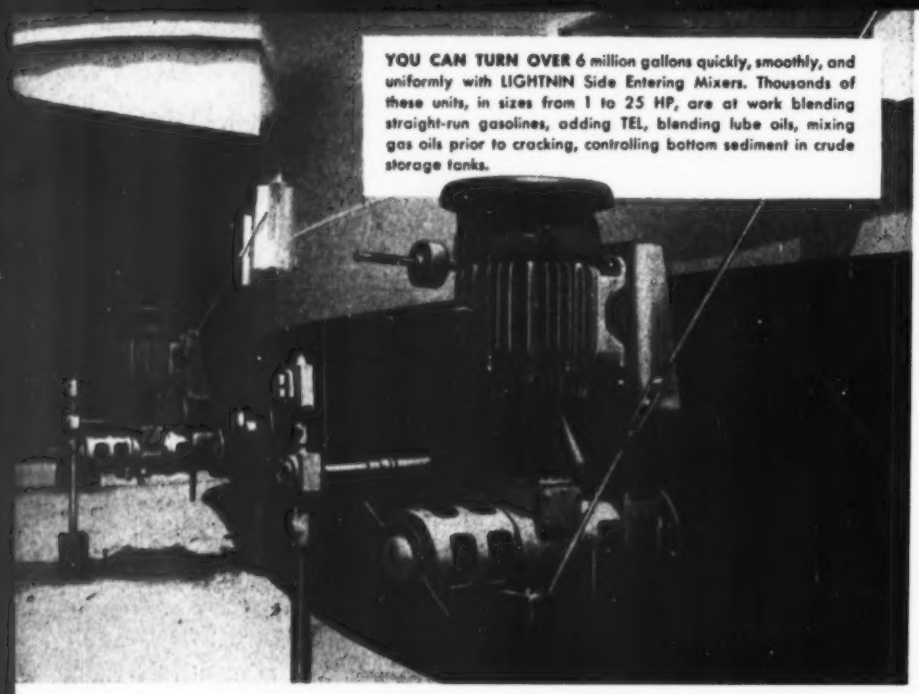
The British Institute of Management issued a report to inform English businessmen to cease and desist with the notion that American production methods will work only in America.

The report was on the building of Esso Standard Oil Company's refinery at Fawley, about 83 miles southwest of London, under the supervision of a 70-man management team.

At the outset, the British squinted at the Americans' production schedule and sniffed that the job could be done in the allotted time nowhere but in America, land of money and materials unlimited.

But when the 6½-million ton capacity unit was completed four months ahead of schedule, the British began to wonder how come. Here are some of the reasons discovered:

- Plans were so detailed that the need for 40 tons of welding rods was estimated accurately two years in advance.
- By using mechanical equipment of all kinds, less than 2 percent of the man-hours consumed were spent in handling materials.
- When rail deliveries were slow, the Esso men sent out trucks to collect materials.
- When work was slowed on one job because of



YOU CAN TURN OVER 6 million gallons quickly, smoothly, and uniformly with LIGHTNIN Side Entering Mixers. Thousands of these units, in sizes from 1 to 25 HP, are at work blending straight-run gasolines, adding TEL, blending lube oils, mixing gas oils prior to cracking, controlling bottom sediment in crude storage tanks.

How to be on safe ground when you plan for fluid mixing

A refinery engineer recently found he had been allowing two hours for a mixing operation that, when correctly done, took 15 minutes.

Why take chances with fluid mixing —when it's so easy to *be sure* you're right?

You can get the right data-answer for *any* fluid mixing problem — quickly, without cost or obligation — by handing the problem to your LIGHTNIN Mixer representative.

He eliminates guesswork and risk, by giving you an unqualified guarantee of *successful results*.

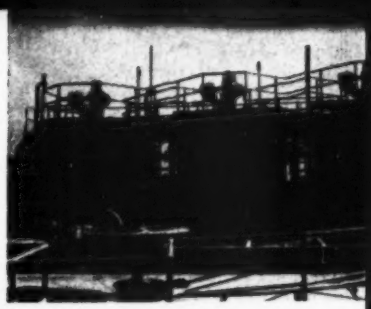
His approach to your problem is sound, fundamental—yet fully in step with today's processing methods.

His recommendations are based on 25 years of research and field experience on thousands and thousands of applications.

Save on upkeep, too

He can show you the way to maintenance savings you may never have thought possible with fluid mixers. A sensible program for reducing machine obsolescence, and keeping replacement costs low.

Before you select a fluid mixer for *any* purpose, find out how much time and effort you can save by checking first with MIXCO. Get the facts now on the LIGHTNIN guarantee that protects you unconditionally. Call in your LIGHTNIN representative—or write us today.



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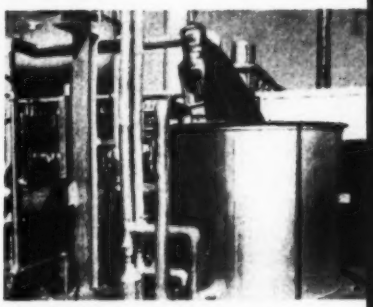

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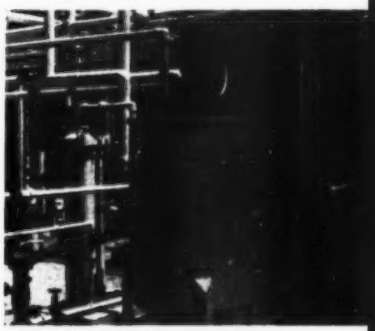

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a materials shortage, workers were transferred to another.

• Needing lots of concrete, and promptly, Esso built a plant on the Fawley site.

Less tangible but no less valuable to the work schedule were the human qualities brought to the job—the drive and enthusiasm of the engineers, the all-around willingness to "muck in" when the going was rough. British laborers were amazed when their American foreman took the tools from their hands and showed them how to do a job.

Said London's *Daily Mail* of the achievement: The Americans did things at Fawley which we must introduce into British industry."

Market Outlook Better

A MUCH BRIGHTER outlook for industry markets exists today than anytime in the past several months, and further improvement seems quite likely.

Reduction in the rate of growth of gasoline stocks during recent weeks and the introduction of the motor fuel consuming season have resulted in the improvements, although gasoline prices continue to be soft under the impact of record-high inventories. However, it now appears that widespread price drops may be avoided.

During April, gasoline inventories will start declining as consuming rates begin their seasonal upswing. This increased consumption should strengthen sagging motor fuel prices, thereby easing the strongest influence that has threatened general price breaks.

The next several months will offer excellent opportunity for the industry further to improve its market situation. Much can be achieved by refiners holding their volume of gasoline produced to reasonable levels, which would allow current excessive gasoline inventories to be reduced to less burdensome volumes.

Encouraging was the improvement during the past month in the gasoline situation, although stocks continued to increase to peak levels. On March 20, there were 179 million barrels of gasoline in storage. However, that was only 3 million barrels above a month ago, and represented a slower rate of growth than previously. Consequently, the amount of gasoline in tanks was only 16 million barrels above a year ago, while it had been 21¼ million higher on February 14 and 23 million greater than the previous year at the beginning of 1954.

Gasoline stocks have reached their peak and from now on will decline due to stepped-up demand of the motoring season. The turn normally occurs in early April.

Today's Vision And Courage

REFERENCE TO the important part played by research in the processing industry has been made, and not infrequently, in these columns. That happens because perhaps few industries have taken more forward steps along research lines than petroleum especially during the past 15 or 20 years. And those steps have paid off, not only for the industry itself but for the public in general. What we can do with a drop of oil today offers an almost unbelievable panorama of accomplishment much of which was undreamed of only a few short years since. Research to a great degree is responsible, research based on industry vision and backed with industry dollars.

Here's how E. I. du Pont de Nemours & Company's president, Crawford H. Greenwalt puts it:

"Today it is research that gives the American economy its characteristic surge and its dynamic qualities. And research requires people with the same courage, vision, and determination as those who a century ago crossed the Western Plains.

". . . There is no essential difference between the explorers and homesteaders of the past and the scientific pioneers of the present. Both require faith in their objective, confidence in the future, and the knowledge that the rewards of success are there to be reaped and kept if success attends their efforts."

Four Times As Fast

THE ORGANIC chemical industry is growing at a rate four times faster than all U. S. industry. At least 100,000 new jobs will be created during the next ten years as a result of this tremendous rate of expansion, according to Cary R. Wagner, president of the Synthetic Organic Chemical Manufacturers Association.

"There are no limits to our opportunities," said Dr. Wagner. "For example it's a good guess that better than half our production of chemicals twenty years from now will be in products unknown today."

Of course, realization of such growth as predicted by Dr. Wagner would have terrific impact on the petrochemical industry. It has been estimated that about 70 percent of all organic chemical production, on a weight basis, was produced by the petrochemical industry in 1952. Experts have predicted that the petrochemical share of the total would increase during these next ten years. Putting these two together the petrochemical industry will continue to establish phenomenal growth records as it has in the past.

A Petroleum REFINER Interview

with F. ROE WEISE

Associate Director, Industrial Relations Department
Standard Oil Company (Indiana)

Some Proposed Taft-Hartley Changes Are Dangerous to Oil

WEISE

Q. *What do you think of the Taft-Hartley Law as it now stands?*

A. I think it is a pretty good law. There are a few things our experience would lead us to change, though. Some of these changes would be in the direction of providing better protection for employes. Some of them would be to define a little more clearly the rights of the employers. Most important, others would be designed to look after the interests of the public.

Q. *What are your general views on the amendments requested by the President in his recent message?*

A. I thing some of them would improve the law, others would damage its effectiveness.

Q. *Which of the amendments requested by the President are, in your opinion, of greatest importance to oil industry?*

A. These are the ones I think the oil industry should be most interested in:

- The amendment which leaves it up to the General Counsel of the National Labor Relations Board to decide whether he will seek an injunction in a secondary boycott case.
- The amendment making lawful a boycott against an employer doing "farmed out" work.
- The amendment providing that fact-finding boards appointed under the National Emergency Provisions may not only find facts but may make recommendations as to the terms of settlement.
- The amendment increasing "states rights" in the handling of labor matters.
- The amendment providing for a secret strike ballot.

Q. *What difference does it make to the oil industry whether the General Counsel* is required *to get an injunction in a secondary boycott case or simply* may *if he sess fit?*

A. Government officials sometimes find that it isn't politically desirable to rile a labor union. If they have an option, therefore, they are likely to find some excuse for not taking action against the union. If they have no choice, they will go ahead and do their duty. We saw an instance of this during the oil strike of 1952. One of the storage and carrier outfits has a terminal at Chicago. Many of the struck companies normally store products and haul out of there, supplying the city of Chicago. The striking unions put up a picket line around this terminal. Contract carrier truck drivers refused to go through it. This was a secondary picket line because there was no dispute between the terminal proprietors and the picketing unions. The General Counsel's office of the National Labor Relations Board told the union that they would get an injunction if the picket line continued. The picket line came down. I cannot prove it, of course, but I am satisfied in my own mind that if it hadn't been mandatory that the injunction be obtained, the board would not have taken action. As a result, the city of Chicago would have suffered hardship. The industry should oppose this change.

Q. *How does this "farmed out work" provision affect the oil industry?*

A. As the law now stands, a union having a dispute with Company "A" cannot picket the plant of Company "B" who is making a product which will be sold by Company "A" to its customers. That is because the union has no dispute with Company "B" and, therefore, its picketing would be a secondary boycott. Under the proposed amendment, such picketing would be lawful. This is dangerous to the oil industry because of its intermingled products, exchange agreements, etc. One barrel of "farmed out work" could render a 100,000-barrel refinery subject to picketing. The industry should oppose this one with vigor.

Q. *I understand you consider it undesirable for emergency fact-finding boards to make settlement recommendations. Why?*

A. We have had some experience with this. Do you remember when the Wage Stabilization Board made recommendations in the steel case? These recommendations were used as the basis for President Truman's seizure of the steel industry. He virtually said to steel, "You agree to the recommended basis or I'll seize you." At about that time the oil cases were before the Wage Board. We were very fearful we would meet the same fate as steel. It happened we had another basis to refuse to appear before the board and thus were saved. Later, and we can be very thankful for this, the Supreme Court held that the President has no right to make such seizures. I feel that panel or board recommendations as to settlement terms bring us one step closer to compulsory arbitration, which, I think, is

See TAFT-HARTLEY, Page 257

How Old is TOO OLD?

Chronological age is no measure of ability. Healthy men over 60 can outproduce their juniors. So why discard them?

Irving Ladimer,
Washington, D. C.

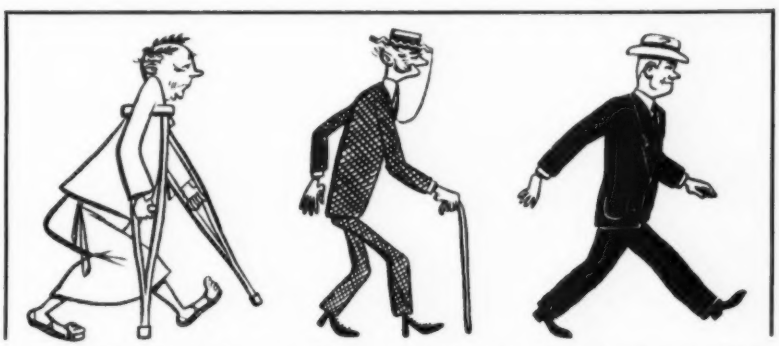
SOME WEAR OUT, some rust out and some are forced out!

This stark summary of use and age applies to men no less than machines. But management has sometimes given less eye and ear to the men than to the machines with which they produce, develop and refine.

In petroleum refining, an industry with a heavy stake in equipment and tools, the wary operator knows the value of full use of his material investment. He knows that rust, scale, obsolescence and neglect slim margins, cut profits. He sees to it that his working inventory is kept trim and up-to-date. He stresses flexibility and new uses for his light and heavy gear and tries to get the most out of it right up to the minute it's slated for the scrap pile.

Men Versus Machines—When mechanical factors are favored over human factors, industry gets poor labor return and falls short in commanding worker loyalty and respect. In tight labor periods, some management has also fallen short in production, because it has not had the vision to consider human needs and earn staff support.

The company which has gone beyond the legal requirements of workmen's compensation, old age and unemployment benefits and sick pay (in some states), has generally fared better in getting and holding a work force and in capturing community esteem. Attention has been given to safety, to recreation and welfare, to health exams and, lately, to utilization of older workers and guiding them into fruitful retirement. These fringes pay off in higher morale, employe pride, and security and family interest. For the company, it multiplies income directly in higher and better production; indirectly through less sickness absenteeism, reduced turnover, abbreviated training costs, and—not to be overlooked—lower retired pay and other costs of benefits due *after the job*. Instead, he gets work *on the job* from experienced, satisfied help.



In ancient Rome, life expectancy was 23 years at birth. A century ago, an American over 40 was living on borrowed time. In 1950, the average life span of an American was 68 plus. Where does the mandatory retirement age fit into this pattern of lengthening usefulness?

It is important to have a complete employe program, especially when rival employers and rival industries, in today's market, compete lustily with such inducements. Stopping at third base adds no more to the score than striking out. You've got to bat the runner home. Or at least try.

When we consider that by 1980, $28.8 billion for pensions of $100 a month might be paid to an estimated 24 million persons over 65 for *not working*, budget-balancing becomes a national nightmare.

Old But Not Out—When the Census Bureau recently changed its big register announcing a U. S. population of 160 million, many envisioned a smiling airborne stork carrying another bundle from heaven. True, of course, but the peak population figure owes its existence as much to continuing lives and fewer deaths as to new lives.

The number of people in this country has doubled in the last 50 years. The number of middle aged (45-64) has tripled and the oldsters (65 and over) has quadrupled. Today there are about 35 million at the half-century mark; and over 13 million are 65 or past, and this group is growing about 400,000 a year. One in every 12 is 65 or older.

How does this happen? Even though births are now on the increase, life expectancy and good health have generally advanced more steadily and markedly. Many childhood and infectious diseases have been licked. More of us are putting off the undertaker and many of us are living longer. In ancient Rome, life expectancy was 23 years at birth. A century ago, an American over 40 was living on borrowed time. In 1900, you were past the average at 48 years. In 1950, the

See TOO OLD, Page 260

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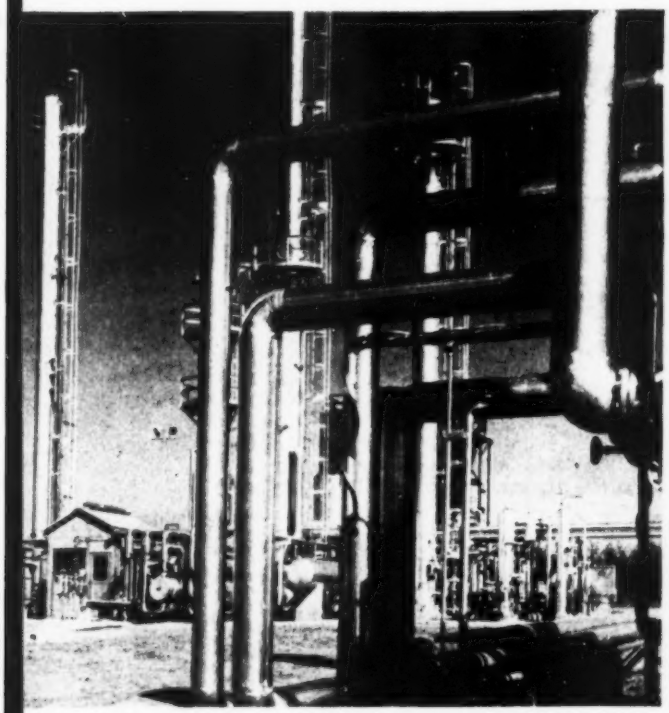
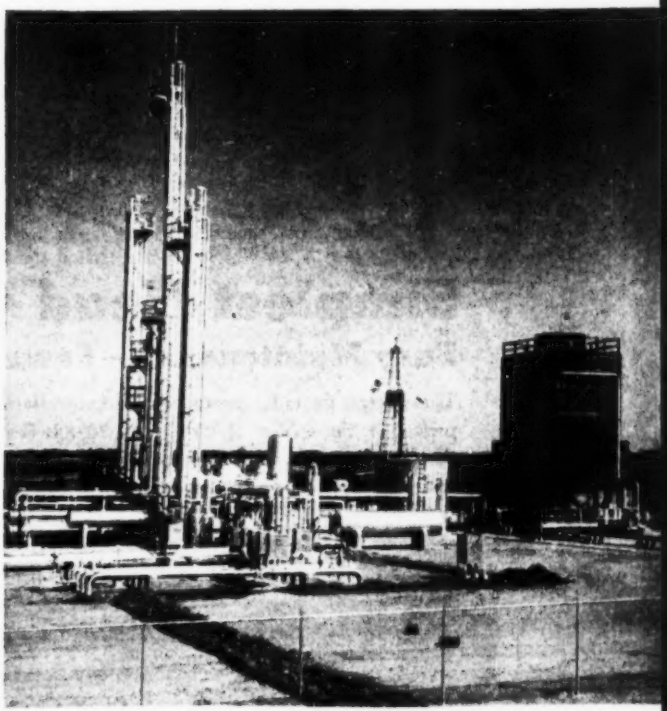


Looking through heater piping at the process area of Sohio's Elmore natural gasoline plant.



Looking northeast at the same area, with cooling tower at right and meter runs in foreground.

It's Paying Off for Sohio

In its first full-fledged natural gasoline plant venture in the Eola Field in Oklahoma, Sohio is finding success.

The first natural gasoline plant to be constructed, operated and 100 percent owned by Sohio Petroleum Company is proving to be a profitable venture for that company. Located in the center of Eola Field in southern Oklahoma, the Elmore natural gasoline plant prepares casinghead gas for sale to a gas pipe line and recovers liquid hydrocarbons previously wasted. Sohio is the wholly owned producing subsidiary of The Standard Oil Company (Ohio).

The plant is currently recovering approximately 5500 gallons of 18 psi RVP natural gasoline and 11,500 gallons of 115 psi LPG per day from a gas inlet volume of approximately 13 Mmcf a day. Prior to the plant project, all gas production in the field was vented to the air with the exception of that volume of gas required for field operations.

Sales Before Completion. After final specifications were prepared and the contract for engineering, construction and other required services awarded, field construction started in December, 1952. The compression facilities were put in operation in June, 1953, and the processing facilities in November, 1953. Since it became possible to sell gas prior to the anticipated plant completion, the field gas gathering system and compression facilities were readied for operation prior to the processing facilities.

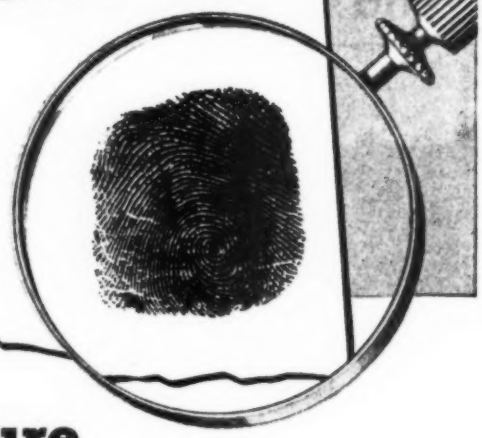
Compression and Processing. The compression facilities consist of one 660-hp. compressor which has a capacity of approximately 4 Mmcf a day. The processing facilities, composed of the standard absorption-distillation-fractionation units, have a capacity of approximately 13 to 14 Mmcf a day of gas and 25,000 to 30,000 gallons a day of liquid hydrocarbons. The plant was designed to recover 90 percent of the normal butanes and 98 percent of the pentanes and heavier hydrocarbons contained in the inlet gas. It has the flexibility required to manufacture natural gasoline of any grade, from 12 to 26 psi RVP, and a butane-propane mixture (LPG) with vapor pressure from 90 to 125 psi.

The rich casinghead gas passes through an absorber where the LPG and natural gasoline hydrocarbons are absorbed in a lean oil (similar to kerosine) stream. LPG and natural gasoline are separated from the lean oil stream in a stripping still. The final products,

See SOHIO'S SUCCESS, Page 195

Positive Identification

Just as a person's fingerprints offer positive individual identification, so the design features of G-R Twin G-Fin Sections distinguish them from all other types of heat exchangers. They are positively G-R.



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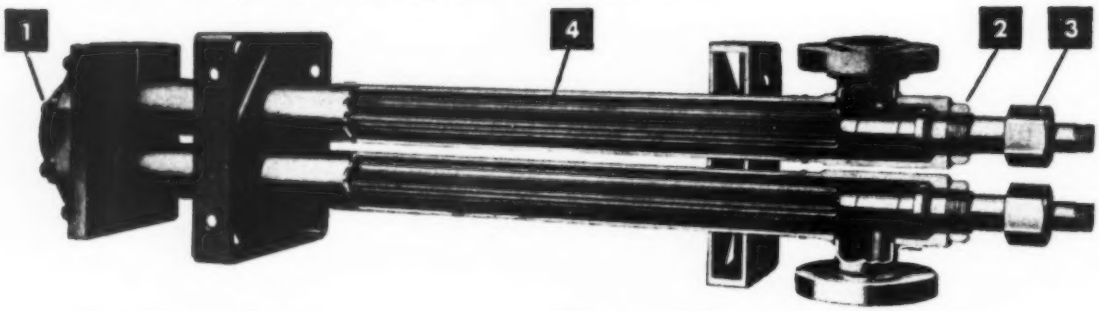
This design provides greater ease of installation, as has been proved in the service of more than 70,000 G-R Twin G-Fin Sections on a greater variety of condensing, cooling, heating and heat exchange services than any other design on the market.



To Remove Element—

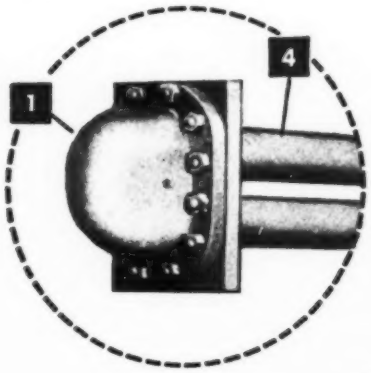
Take off shell cover (1)
Loosen and remove cone plug lock nut (2)
Loosen and remove union nut (3)
Remove element (4)

To Replace Element—

Insert element (4)
Replace and tighten cone plug lock nut (2)
Replace and tighten union nut (3)
Replace shell cover (1)

Domed Shell Cover

This type of shell cover is particularly rugged, yet weighs only 17 pounds for the small sections and 43 pounds for the standard high capacity sections.



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G-R Twin G-Fin Section

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Foreword to . . .

1954 Natural Gasoline Issue

DAY-TO-DAY problems in the natural gasoline industry are still important but the big question now is what's going to happen to prices. This year natural gasoline price hasn't recovered its usual seasonal rise and the industry is frankly worried.

Historically, natural gasoline has been a step-child. Prices (unlike crude oil) have fluctuated according to spot quotations—refineries paying good prices in times of blending need and low prices in times of high refining inventories. Previously, natural gasoline has been an excellent blending agent because of its relatively high octane and high volatility. As the octane race continues, these advantages are disappearing. With the installation of catalytic cracking and reforming, both octane and volatility can be handled very well at the refinery.

The immediate picture is aggravated by high inventories of motor fuel at refineries. But the industry still has to answer the question: What's going to be done about natural gasoline quality?

At the outset, if natural gasoline is going to be reformed, the refineries have the edge for doing the job—larger unit production, integrated research and development facilities, ample utilities, and stable market outlets. But don't discount some reforming activity in the natural gasoline industry itself. Large plants can justify reforming and combination of several plants' production could, too. Just how this problem will be proportioned is what only the future will tell.

No matter where natural gasoline is reformed, natural gasoline pricing is in for an adjustment. Present pricing is somewhat artificial and should give way to pricing natural gasoline on the basis of its reforming value—perhaps escalated with the price of crude oil. Freight price should also give way to pipeline cost rather than the present tank car basis.

We can take a look at allied products of the natural gasoline industry with a little more assurance. Sometimes they can be the tail that wags the dog.

Natural gas production and use is still booming. Prices are still climbing and will continue to do so until they reach competitive fuel levels – coal and fuel oil. Still being discussed is the battle to change the pricing from a volumetric to a heating value basis.

Ethane, though, is the speculative product. So much here depends on specific location that it's hard to say what activity to expect. When a petrochemical plant goes after an ethane supply, the contract is tailor-made and doesn't establish much precedence.

You can expect propane recovery to increase and price to follow in that direction. Reason: increased use of propane as a motor fuel. If natural gas pricing does change to a heating value basis, look for propane prices to jump—it will be worth a lot more in natural gas fuel.

Butane is the plentiful product now. Prices will probably go lower for the same reason that natural gasoline prices have been depressed. Underground storage has taken out seasonal variations in supply and butane's inherent low vapor-pressure gives it a disadvantage in the LPG market. A bright spot for butane is its further use by the petrochemical industry, e.g., butadiene manufacture.

These economic considerations prompted us to interview an industry expert on gasoline plant justification which you will find as the leadoff article in this special issue. We're also bringing you up-to-date on some of your most perplexing day-to-day problems, as you will see in the table of contents below.

Editorial Director

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Interview with a gasoline plant specialist . . .

Do Gasoline Plants Pay Out?

Are we reaching the point where there isn't enough difference between the price of the unprocessed gas and the gas converted to liquid through a plant process to justify installation of a plant?

Seeking answer to economic changes in the industry, Petroleum REFINER interviewed Harold E. Vaughan, regional chemical engineer for Continental Oil Company, to find out the thinking of industry experts.

Harold E. Vaughan

Q *Mr. Vaughan, would you say that the trend in natural gas prices has created an entirely new picture of gasoline and cycling plant economics?*

A Yes, I think we must recognize that the value of natural gas in the field has increased fantastically in the last few years and will continue to increase until it has reached a competitive level with other fuels. This is of particular importance to the designer and operator of natural gasoline and cycling plants because as the value of gas increases, fuel and shrinkage losses become more and more of a major economic factor.

Q *What has been the recent history of natural gas pricing?*

A In the early days of the industry, an oil company or independent producer was fortunate to sell the gas at any price. As late as the mid 1940's three and four cents per 1000 cubic feet were common prices in the Southern states for gas delivered to a central point. In those days, little if any consideration was given to the amount of gas used in gasoline or cycling plant operations. The almost valueless residue gas was plentiful and it was used without restriction and in many cases wasted at the discretion of the operator.

Many long term casinghead and gas well gas processing agreements were entered into with provisions for relatively small percentages of the residue gas being credited to the plant. Some contracts even provided for 100 percent of the gas to be returned to the producer. The chances are, there was little money involved one way or another at the time the agreements were consummated.

Q *When did the scramble for gas begin?*

A About the mid 1940's to the later 1940's, gas prices of 6 and 7 cents were commonly used in choice gas deals. Then came the scramble for gas. Many leading industries invested millions of dollars in plants in the Southern states mainly because of the abundant supply of cheap gas for fuel. In the late 1940's major gas transmission companies were either expanding existing facilities or building new trunk lines from the rich gas and oil fields of Texas, Louisiana, Oklahoma, Kansas and New Mexico to the important markets in the Eastern, Northern and West Coast areas. Continued growth of this industry has provided an outlet for the major portion of all natural gas produced in the U. S. In 1953 of an estimated 9.0 trillion cubic feet of natural gas produced in the U. S., about 7.7 trillion or 84.5 percent was produced in those five states.

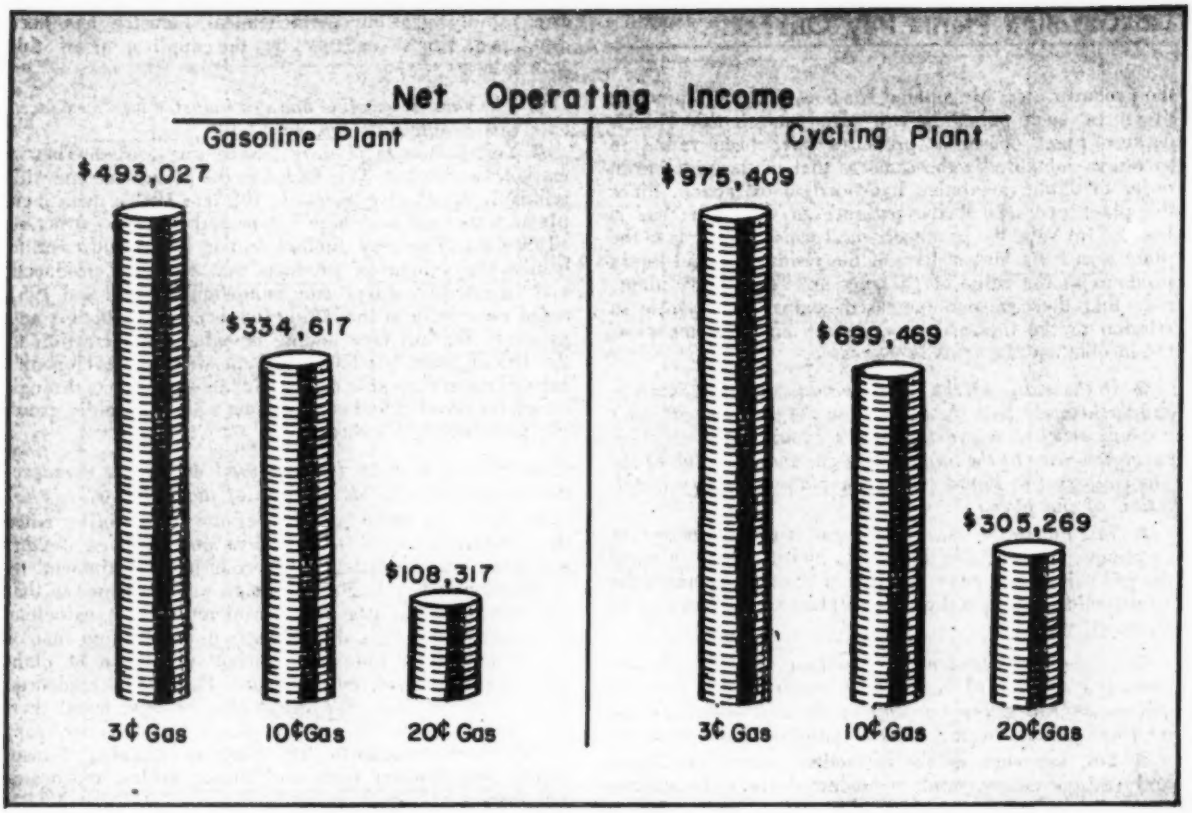
As the available supply of gas not already committed to long term contracts dwindled, competition became keener. In the earlier part of 1951 the contract prices of 12 cents in Northeast Texas and 20 cents in some parts of California set new highs.

Q *And the price of natural gas is still rising?*

A Yes, contracts have been negotiated in the Gulf Coast area of Louisiana, starting at 20 cents per 1000 cubic feet for deliveries beginning this year and escalating to higher prices during the term of the contract. Those prices do establish a trend and set a pattern of the future worth of natural gas in the field.

Q *How does this increasing gas price affect gasoline and cycling plant economics?*

A I think the best way to show the effect is through the accompanying chart. It shows what happens to the net operating revenue of plants when operating conditions and other expenses remain the same and only the price of gas fluctuates.



Q *What was the basis for the gasoline plant chart?*

A The gasoline plant in our example processes about 32 million cubic feet of gas per day from which is extracted about 83 thousand gallons of propane, butane, and casinghead gasoline. Most of the gas is processed at 400 pounds. In this example the only gas charged against plant operations is plant shrinkage and that used in the boilers and the recompression engines. All power in the plant, whether steam or electric, receives its basic energy from gas except for the purchase of about 11,600 kw. hours per day from an outside source. Total gas consumption amounts to 6.2 million cubic feet a day. All residue gas is credited back to the producers. Assuming the value of the gas used in plant operations is charged to the plant, we note that when the value of gas is 3 cents a thousand cubic feet the annual net revenue before income tax is $193,027. With a price of 10 cents per thousand cubic feet the revenue is reduced to $334,617. When the value of the gas is increased to 20 cents the revenue dwindles to $108,317.

Q *This would mean a reduction of about 78 percent in revenue below that when the price is 3 cents?*

A Yes.

Q *What was the basis for the cycling plant example?*

A In a fair size cycling plant processing 173 million cubic feet of gas per day and manufacturing 265 thousand gallons of saleable liquid products from all sources, including distillate, about 10.8 million cubic feet per day are consumed in plant shrinkage and in compression, extraction, and manufacturing operations. At 3 cents this represents $108,260 a year for gas used in plant operations. At 20 cents per thousand cubic feet the figure increases to $788,400. We note that the net revenue before income tax decreases from $975,409 per year at the 3 cents gas value to only $305,269 when gas is worth 20 cents per cubic foot, or a reduction in net operating revenue of about 69 percent.

Q *What other factors have affected gasoline plant economics?*

A There are at least four major factors which help to reduce the net operating income in natural gasoline and cycling plants: (1) In the last few years federal, state and local legislative bodies seem to have found it convenient to increase taxes on the industry almost every time more money was needed by the government. (2) Wages have steadily increased, better than doubling those paid in the early 1940's. (3) Cost of all materials used in such plants have at least doubled and in some cases trebled in the past 12 years. (4) Sale price of liquid products has not kept pace with the increased cost of production.

Q *Will the increased gas price reduce pressure maintenance and cycling operations?*

A Yes, there is a point beyond which the cost of such operations would exceed the value of the additional liquids that could be recovered. This not only shortens the life of the plant but causes the loss of liquid reserve to the plant and producer.

Q *Why isn't it especially favorable for the plant to sell its residue gas at a higher price?*

A Sometimes it is, but such is not always the case. Whereas, for many years it has been the policy to charge

the producer a certain amount for boosting gas to pipeline pressures, such policy is now often questioned. This is because plant operating pressures have been raised to pressures subtantially the same as that of the pipeline in order to obtain maximum hydrocarbon extraction. Since the plant operates at the pressure to which the gas is boosted for sale, the producer who furnishes the gas to the plant asks for a larger share of the residue gas and liquid products as the value of gas goes up. Thus, many plants may find their income increased comparatively little in relation to the increasing gas prices, and in some cases the income may be actually decreased.

Q *If the value of the liquid products doesn't increase proportionately with the increase in the value of gas, isn't a point reached where there isn't enough difference between the price of the unprocessed gas and the value of the gas converted to liquid through a plant to justify installation of the plant?*

A Yes, but in the case of rich gas it may be necessary to remove some of the liquefiable hydrocarbons to make the gas saleable to gas transmission lines even though the construction and operation of the plant can't otherwise be justified.

Q *There is a tendency in certain state legislatures toward enactment of regulations requiring the payment for casinghead gas to be made at the wellhead. Isn't this another setback to the natural gasoline manufacturer?*

A Yes, inasmuch as the extraction losses, fuel losses, and various usages must be deducted from the volume produced before the gas is finally sold to the purchaser. The result of this practice, if it should become law, would mean that it wouldn't be economically feasible to construct natural gasoline plants in many fields which would, under more equitable regulations, support such plants.

Q *Since little can be done about high taxes, wages, cost of materials or the low prices of saleable products in these plants, then what can we do to protect the plant's net income?*

A The first step to take in approaching this problem is to examine some of the important costs that can be controlled from day to day. Labor is always a large item. A job analysis of the plant personnel may reveal that by better planning and organization the over-all operation can be accomplished more efficiently with less man-power.

A maintenance program with emphasis on preventive maintenance requires continuous attention and is always open for improvement toward reducing operating costs of the project.

By close supervision over plant operations and plant control tests, the maximum production can be obtained and cost of chemicals reduced to a minimum.

The quantity of gas used can usually be reduced by eliminating actual waste, such as that which is being flared, and reducing steam and electric power consumption to the bare minimum requirements for efficient plant operation.

A cost-conscious responsibility instilled in each employe through planned educational programs will pay dividends.

Q *Do you look for the development of new products and new uses for old products?*

A Yes, this is a key factor in the economy of any industry faced with increasing cost of raw materials or with increased value of materials formerly considered waste. The rapidly growing petrochemical industry has been developed almost entirely by the application of this principle.

Q *The natural gasoline and gas industry has been faced with this problem before, hasn't it?*

A Yes, in the early days butane was wasted. Then a market was created. This added to the plants' income with relatively small investment. In the late 1940's many new plants were built with high butane and propane extraction efficiencies. The very limited market was insufficient to handle the volume of products that could be produced, and an intensive advertising campaign in 1950 and 1951 aided materially in increasing the demand for butane and propane. We are now adding an ethane-rich fraction to the list of plant products. Perhaps we may develop and expand more favorable markets for those products through closer cooperation and coordination with the rapidly growing petrochemical industry.

Q *What can plant designers and equipment manufacturers contribute to the solution of the problem?*

A They can make a very definite contribution since their future business is dependent on improved designs and processes and better and more efficient equipment.

Gasoline and cycling plant design was developed in that era when residue gas was considered almost valueless. This factor lead to a design basis different from that of nearly any other industry. Efficient utilization of plant fuel was not considered important. This fact is evidenced by the general lack of consideration of economical thermodynamic balance in gasoline plants. Now it is necessary to pay more attention to such things as efficiency of insulation, heat transfer rates, and burner, boiler, and heater efficiencies.

In many instances gasoline plant design hasn't provided for maintenance access and facilities comparable to that provided in other industry plants.

Q *Refinery and chemical plants have found the facilities for maintenance and access to be economical, haven't they?*

A Yes, and they certainly deserve more consideration in gasoline plant layout. Though they require some additional outlay of capital in building a plant, they pay for themselves many times over in savings in operation and maintenance.

Q *Isn't the competence of the design organization responsible for the plant a critical factor?*

A Yet, it is probably more critical to over-all economics than any other factor. The mechanical design and layout of a gasoline plant runs 1 to 2 percent of the total job cost. That factor could be doubled without materially increasing the construction cost of the plant. This additional designing expense will usually reduce the outlay for equipment, materials, and labor by several times the amount expended on engineering. It is possible to consider more alternates to process and equipment specifications and to ascertain that the answers arrived at are the most economical for the plant in question. Construction and operating procedures can be given more weight and the plant tailored to its specific needs, bearing in mind the salvage value of the equipment in connection with the anticipated life of the plant. Actually, this item very seldom increases the over-all investment in a plant and almost always results in more economic construction and operation.

Q *Then it is false economy to skimp on engineering, isn't it?*

A Yes, engineering is the basis for investment and operating costs that determine the economical feasibility of any plant.

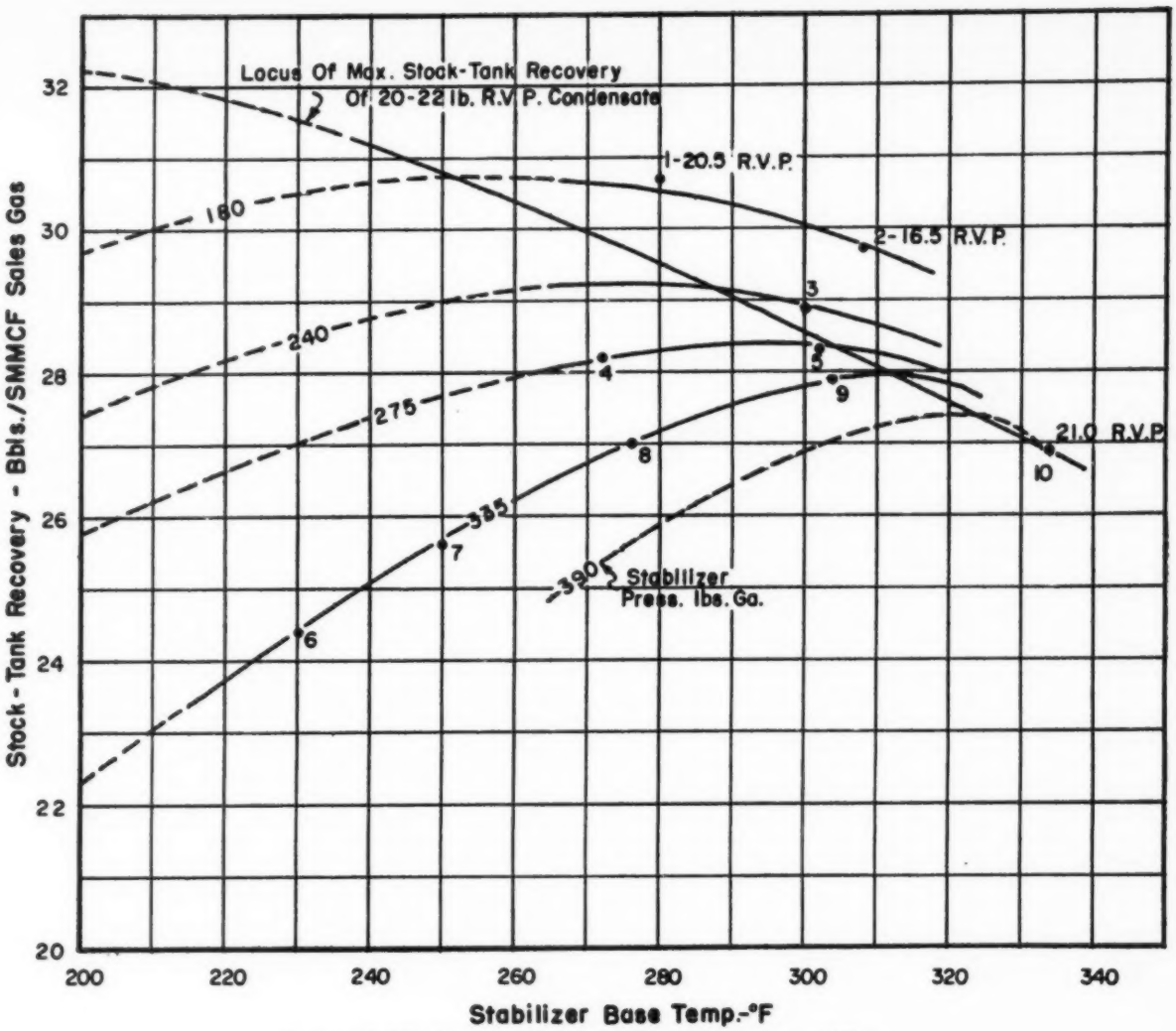


Figure 1. Stabilized condensate recoveries from chilled feed to stabilizer.

Tests show . . .

Low-Temperature Process Advances

- **Stabilization of chilled retrograde condensates offers maximum yields.**
- **Hints outlined for making your own tests on comparative condensate recoveries.**

Edw. G. Ragatz
Edw. G. Ragatz Company,
San Marino, Calif.

RETROGRADE condensate yields have been increased in the last few years by low-temperature separation units. Further increases in these yields can be accomplished by field stabilization of their high-pressure separator liquids. Quantitative data, previously lacking, are presented here

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for typical stabilizer operations.

Briefly, low-temperature separation units recover retrograde condensate by "blowing down" a high-pressure well-stream through an adjustable choke into a gas-liquid separator operating at sufficiently high pressure to permit direct delivery of the separated gas into a fuel-gas transmission line (normally 750-900 pounds gage). Before "blowing down," the well-stream is precooled to a temperature approaching incipient hydrate formation. As a result of this preliminary cooling, the gas withdrawn from the separator is chilled to a low temperature (normally 15-30 F.) and has its water content sufficiently reduced to be acceptable for pipe-line transmission without additional treatment.

The resultant retrograde condensate is similarly chilled as it emerges from the inlet choke in intimate contact with the expanded gas stream. This low temperature forms the basis for the potential yield increases of the low-temperature separation units. This temperature, however, also results in a state productive of hydrate formation irrespective of whether or not free-water may have been removed from the well-stream ahead of the separator inlet choke. According to the specific equipment design, the condensate may then be heated within the high-pressure separator to melt the hydrates, or an inhibitor may be employed to prevent their initial formation, or the hydrates may be allowed to form and then be continuously withdrawn from the separator in highly dispersed form in the condensate. This latter operation represents the most recent form of high-pressure separator development.

Irrespective of which method is employed for coping with the low-temperature hydrate problem, the resultant high-pressure condensate carries with it a very substantial quantity of undesired low-boiling fractions. Efficient removal of these fractions has a major bearing on how much of the unit's potential yield is actually realized at the stock tank, and even more pertinently, at the point of ultimate utilization.

The majority of today's low-temperature separation units heat the high-pressure condensate to the region of 80 F. for hydrate destruction, and then blow it down to a 40-80 psig low-pressure separator before transfer to the field stock tank. The low-pressure "flash" vapors from these latter operations are normally blown to the air and carry with them a substantial volume of desired higher-boiling fractions. It is the recovery of these presently-lost desired fractions, plus the ability to accurately control the vapor pressure of stock-tank liquid (and hence reduce subsequent transportation and blending losses) which makes field stabilization of the high-pressure separator condensate desirable.

While the structure and operation of the conventional stabilizer is relatively complicated due to its refluxing of condensed overhead vapors, the character of the separation desired for the high-pressure condensate, plus its initial low temperature (particularly when not heated for hydrate destruction) make a simple non-refluxing, automatically re-boiled, rectifier appear attractive for condensate stabilization service. In keeping with this analysis, a number of carefully controlled check tests employing both heated and chilled feed-streams were run some time ago on such a stabilizer.

As the name implies, the stabilizing unit employed in these tests used no reflux. Raw high-pressure condensate was fed directly to the top of a 20-tray rectifying column, and the stabilized condensate was withdrawn from the bottom of the column after reboil-heating at a salt bath heater. Discarded vapors produced by this stabilization, plus the vapors originally flashed from the feed-stream as it entered the column, were withdrawn directly from the top tray of the unit with no further treatment. Lack of subsequent reflux-treatment of these feed-tray vapors, plus associated lower separator-effluent gas temperatures, account for the higher potential yields shown for the "chilled-condensate" phase of these tests.

A several days' run employing a conventional dual-separator operation with the high-pressure separator operating at 940 psig and 68 F., and the low-pressure separator operating at 85 psig and 60 F., produced 24.5 barrels of 20.4 RVP condensate per smmcf of high-pressure sales gas. This figure constituted the base "yard stick" for subsequent evaluation of the low-temperature separator tests. These tests were intended to develop the differences in yield and/or relative advantages of:

- Low-temperature separation with subsequent heating of the high-pressure condensate for hydrate destruction, followed by simple low-pressure separation and a final stock-tank flashing of the "heated" condensate.
- Low-temperature separation as above followed by non-refluxing stabilization of the "heated" condensate feed.
- Low-temperature separation followed by stabilization of a "chilled" (non-heated) condensate feed.

In keeping with the above schedule, a carefully run test employing conventional low-temperature separation at 920 psig with condensate subsequently heated to 70 F., followed by an 85 psig second-stage separation at 58 F. and a final stock tank flash, produced 27.5 bbls. of 21.0 RVP condensate per smmcf of high-pressure sales gas.

An extended series of tests were then run with a non-heated condensate feed to the stabilizer. These tests covered a wide range of stabilizer pressures and base temperatures, and looked to development of a broad definition of the "chilled-feed" operation. The majority of these tests fell into a well defined pattern as exemplified by the 10 tests summarized in Table 1 and plotted on Figure 1. As shown in the table, pressures employed ranged from 178 to 390 psig, and temperatures from 230 to 334 F.

Full significance of the recovery relationship developed by these tests was not recognized until the data were plotted as in Figure 1 after the test operation had been discontinued and a substantial portion of the test equipment removed. As indicated by the "recovery locus" line of Figure 1, this plotting revealed that a significant increase in 21-22 RVP condensate recovery should be effected by operating the "chilled-liquid" fed stabilizer at pressures of the order of 35-50 psig instead of the minimum 178 psig of the actual test series. While it was too late to check these observations by actual field operation,

TABLE 1
Stabilized Yields From Chilled H.P. Condensate

Test No.	Stabilizer		Stock Tank	
	psig.	Bots. °F.	°F.	Bbls./ SMMCF
1	182	280	62	30.7
2	178	308	80	29.7
3	240	300	82	28.9
4	275	272	77	28.2
5	273	302	81	28.3
6	331	230	80	24.4
7	335	250	84	25.6
8	335	276	88	27.0
9	335	304	77	27.9
10	390	334	77	26.9

subsequent careful calculation indicated a potential recovery of 32.5 barrels of 20.5 RVP condensate per smmcf sales-gas for a 35 psig stabilizer operation.

The stabilizer base temperatures traversed by this "recovery locus" are those temperatures which will produce (at the pressure in question) the maximum amount of stabilized liquid which can be held in the stock tank at prevailing tank temperatures *without* an accompanying stock-tank "flash." If the column is operated at a temperature lower than this optimum, additional desired fractions will be lost at the tank. If the column is operated at higher than optimum temperatures, additional desired fractions will be lost at the stabilizer column. Both of these operations will result in a reduced stock-tank yield.

Finally, a series of tests employing a "heated" condensate feed were also run at the stabilizer. These tests covered a range of pressures paralleling the "chilled-feed" tests, but in their case "bracketed" the pressure range required for maximum 20-22 RVP condensate production, namely 200-250 psig. The maximum yield obtained from this second test series was 29.9 barrels of 20.5 RVP condensate per smmcf of high-pressure sales gas.

Yield results from these various tests, together with our calculated ultimate low-temperature condensate yield, are summarized in Table 2. Further testing has shown that these yield figures are only approximate and that they lack the test precision required for an authoritative quantitative comparison of the various operations under consideration. However, the magnitude of the test yield-differences definitely indicates an economically significant increase in efficiency for each recovery step from the old dual-separator operation through to low-pressure stabilization of a *chilled* high-pressure condensate.

TABLE 2

Yields of Stock-Tank Condensate

OPERATION	Avg. R.V.P.	Above Choke Pres. psig	H.P. Separator Pres. psig	H.P. Separator Lqd. F	H.P. Separator Gas F	Stabilizer Pres. psig	Stabilizer Bots. F	Stock Tank °F	S.T. Product Bbls./ SMMCF Sales Gas
Std. dual-separator with stock-tank flash	20.4	2530	940	68	68			67	24.5
L. T. separator with heated cond. and L. P. flash	21.0	2520	920	70	21			66	27.5
L. T. separator with heated cond. and stab.	20.5	2520	925	70	21	250	323	67	29.9
L. T. separator with chilled cond. and stab.	21.5	2500	930	23	17.5	182	280	62	30.7
L. T. separator with chilled cond. and stab.*	20.5	2500	925	20	18	35	165		32.5

* Calculated Yield.

TABLE 3

Typical Condensate Analyses

(In Mole Percent)

	High-Pressure Separator Liquid			Stabilized Condensate			20.4 RVP dual-separator stock-tank cond.
	Conv. @ 68F-940 psig	L. T. @ 15F-897 psig	L. T. @ 80F-897 psig	16.5 RVP	19.0 RVP	22.5 RVP	
CO_2		1.90	1.70				
C_1	25.00	24.50	19.78				
C_2	8.00	8.20	8.27				Tr
C_3	8.84	11.35	11.98	1.69	4.61	5.10	5.31
iC_4	2.95	4.22	4.05	5.25	6.25	6.68	4.16
NC_4	5.47	9.19	9.85	12.91	11.75	13.10	6.39
iC_5	4.19	3.76	4.50	6.65	5.83	7.53	5.95
NC_5	1.81	3.92	4.23	6.88	5.91	4.89	3.01
C_6	10.06	7.45	8.04	17.34	15.17	16.24	29.02
C_7	33.68	25.51	27.60	49.28	50.48	47.05	55.36
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 3 presents typical analyses of the high-pressure condensates produced during these tests, together with their associated stock-tank liquids. In comparing the individual analyses of this table, it should be remembered that they were taken at different times and reflect small differences in both well-production composition and laboratory precision. After allowing for such secondary discrepancies, comparison of these analyses should give a first order conception of the condensate composition differences associated with the various high-pressure separator operations, and their associated stock-tank products.

The economic significance of the relationships developed by this test series calls for additional testing of sufficient precision to permit accurate quantitative evaluation of the qualitative differences. In running such tests, it should be recognized that they involve *accurate* evaluation of *differences* in relatively small percentages of the test-defined gas and liquid quantities. On this basis, our experience indicates that the following precautions should be taken when running tests looking to precise quantitative comparisons of various retrograde-condensate recovery operations.

1. Deadweight check all pertinent pressure gages before and after the test runs.
2. Employ at least 10-inch charts on all meters, and adjust the orifice sizes and/or meter ranges so the flow-differentials fall on the upper half of the charts.
3. Employ recording thermometers on the metered gas streams, or take sufficiently frequent temperatures, so the temperature factors for the meter coefficients can be selected with confidence.
4. Run sufficient gravities on the gas streams so the gravity-factors can also be selected with confidence, particularly when comparing operations yielding different sales-gas gravities.
5. Include in the test data the pressures carried on the well-stream line ahead of, and the sales-gas delivery line beyond, all equipment associated with the separator operation. This pressure history will give notice of any changes in the well operation for a fixed setting of the separator inlet-choke which might be reflected in the units operation and/or recovery.
6. Check the stock-tank production gauges with temperature-compensated displacement meters when dealing with stabilized liquids.
7. If substantial variations in sales-gas delivery pressures are anticipated for the test period, provide a back-pressure regulator for the high-pressure delivery line whereby a somewhat higher than maximum anticipated delivery pressure may be consistently maintained on the separator during the test period.
8. Take all pressure samples by water displacement, with the sampling period spread over a sufficient time to assure that the resultant sample is representative of the average operation of the well.
9. Many wells vary their hourly and/or daily production rates over a several-day cycle. The well should be initially checked for such cycling by taking 12-hour consecutive gages of the stock-tank production over a several-day period with a fixed choke setting. If the well shows such a cycle, then all test runs should be timed to properly cover a "full cycle" period.
10. Twelve-hour consecutive gages should also be taken during the test period for checking on the consistency of gages, and particularly for checking the test period correlation with the well-cycle period, if such exists.

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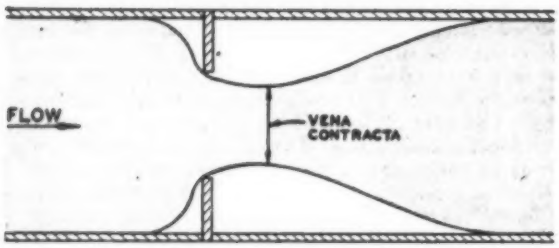

Figure 1. Normal flow: Sharp, square edge orifice plate.

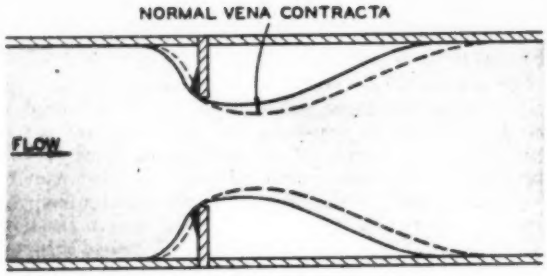

Figure 2. Erroneous flow: Orifice having rounded up-stream edge.

Check your installations for . . .

Orifice Meter Accuracy

Don't expect accurate gas measurement unless you follow AGA specifications.

W. R. Kehoe,
American Meter Company, Inc.,
Erie, Pa.

THE "ORIFICE METER" is not just the differential pressure gage as many so often think of it. The orifice meter is a combination of the orifice plate, meter run, gage lines, differential gage, and static pressure element. The combination of all of these component parts forms the orifice meter and enables us to measure a flowing gas.

To avoid the necessity of calibrating orifice plates individually in the meter run in which they are to be used, definite specifications have been set up by the American Gas Association on the orifice plate and meter run to permit duplication of the basic elements from which the orifice coefficients were originally determined. For this reason, strict adherence to those specifications is necessary if accurate measurement is to be obtained. Probably the most important requirement for the orifice plate is that the upstream edge be square and sharp so as not to appreciably reflect a beam of light. Various other specifications, such as flatness, edge width, etc., should also be followed because deviation from established specifications might result in an accumulation of additive errors. Since an accurate record of differential pressure and static pressure is requisite for good gas measurement, presume for the moment that the meter run and orifice plate were constructed according to established specifications at the time of initial installation, and give concern only to those deviations from ideal flowing conditions which might result from continued use and cause error in the measurement.

The upstream edge of the orifice might become rounded because of abrasive material in the flowing fluid. A rounding of the orifice edge would result in a low differential reading with consequent low measurement. The diameter of the stream at the "vena-contracta"—the point of minimum cross-section of the stream, downstream of the orifice—largely determines the coefficient of the orifice (Figures 1 and 2). Anything that would tend to increase the diameter of the stream at this point of greatest contraction would increase the discharge through the orifice for a given differential pressure; in other words, it would cause the coefficient to increase. An accumulation of dirt on the upstream face of the orifice might be the equivalent of a rounded upstream edge, since it would tend to streamline the gas approaching the orifice (Figure 3).

An accumulation of dirt in the meter run ahead of the orifice plate could cause either low measurement or high measurement, depending upon the amount of the build-up. If the build-up did not obstruct the orifice opening, its effect would be a streamlining of the flow lines with consequent decrease of differential pressure and resulting low measurement (Figure 4). If the build-up were sufficient partly to obstruct the orifice opening, the differential pressure reading would increase and consequently the measurement would be high (Figure 5).

Any change in the inside surface finish of the meter run might cause a distortion of flow from that corresponding to the conditions for which the coefficients were originally determined and consequently cause an error in measurement. The effect of roughening the inside surface beyond that corresponding to standard selected pipe usually causes a decrease in differential pressure and low measurement. Correspondingly, the use of a smoother inside surface than that which existed inside the meter runs on which the basic data were obtained would introduce an error in the measurement. Variation of the surface finish would result in a consequent variation of the velocity pattern over the cross-section of the pipe in the section upstream of the orifice. For example, a rough inside surface would slow down the velocity of the stream adjacent to the pipe wall; consequently, for a given rate of flow, the center velocity would have to be higher than normal. This higher than normal center velocity would produce a "jet effect" which

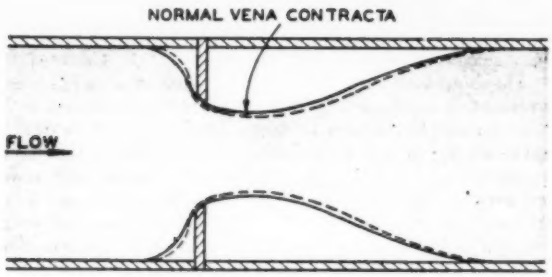

Figure 3. Erroneous flow: Accumulation of dirt on up-stream face of orifice.

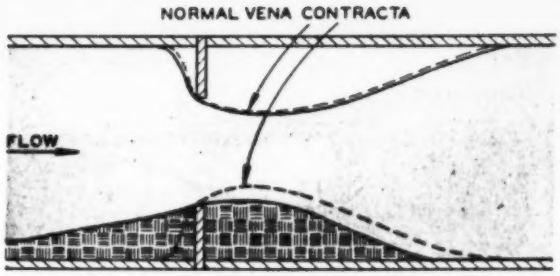

Figure 4. Erroneous flow: Dirt, liquid or foreign material accumulating ahead of orifice.

would distort the vena-contracta with consequent increase in the coefficient of discharge (Figure 6).

Consistently accurate measurement under conditions where the flowing medium contains suspended solids, such as hydrates, offers a real challenge to measurement men (Figure 7). For example, hydrates may start to build up gradually on the upstream surface of the plate, possibly rounding the upstream edge. The result of this initial build-up usually constitutes a streamlining of the channel with a resulting increase of the coefficient. This prevents the plate from producing the correct differential pressure for a given flow, and causes a low reading.

This initial build-up and consequent streamlining of the upstream edge can progress to a point where the build-up can become great enough to start closing in the orifice opening. When the build-up reaches this condition, the orifice plate opening, being actually smaller than it was originally, creates more differential pressure than it should for a given flow condition and the meter reading is too high.

More Troubles—To add further to the meterman's troubles, these foregoing conditions which caused erroneous measurement can suddenly return to proper flow pattern. A sudden change in flow rate, pressure or temperature fluctuations in the line, etc., have been known to dislodge the suspended matter from the orifice plate opening and return the flowing stream to approximately proper conditions. Under these unstable circumstances, it is impossible to obtain accurate measurement. The only solution is to eliminate the hydrates by the addition of heat, the injection of alcohol, or some other suitable agent.

The measurement of wet gas with an orifice meter is extremely difficult, since to obtain accurate measurement it is necessary to know the *actual* density af the flowing fluid as it passes through the orifice (Figure 8). When wet gas is being measured, the liquid is mechanically entrained in the gas stream as minute droplets in the form of a mist. The relatively heavy liquid droplets would create an *actual* density much higher than that which would be measured by a conventional gravitometer. In sampling such a flowing stream, there would be a tendency for the liquid to drop out, since this liquid is held in a state of mechanical suspension because of the velocity of the stream. Sometimes average correction for an over-all time period can be made when the ratio of the liquid to gas can be definitely determined and an average density correction made.

The problem is also complicated by the possibility of liquid condensing out in the mercury manometer chambers. These difficulties can be reduced somewhat by the use of bellows type differential gages with pressure connections made at the bottom of the manometer. With proper piping, this arrangement can be made to be more or less self-draining and do much to prevent the error caused by formation of liquid in the chambers of the conventional mercury manometer.

Periodic inspection of the meter run and orifice plate will insure against any deviations from proper conditions of measurement. The type of measurement and the flowing condition will dictate how frequent such inspection should be. With new lines, where there is a possibility of hydrates, dust, etc., more frequent examination would be required than with an installation where the flowing fluid is relatively clean and stable.

Next, consider the differential gage which measures the pressure drop created by fluid flowing through the orifice. We will assume that the gage lines are tight and that all valves are in good repair, capable of a positive shut-off, and with no leakage at the valve stems. An examination of the manometer will indicate that the reading is a direct function of the difference in levels in the manometer chambers and the consequent rise of the float in one of the chambers.

A comparison of the manometer reading with a suitable water column will indicate not only whether the calibration of the differential gage is correct, but will also serve as an indication as to flaws in the mechanism—such as might result from stuffing box binds, dirty mercury, or from an incrustation on the manometer walls. The water gage is attached to the high side of the manometer and a comparison of readings can be made by a manipulation of the valves in the gage lines.

It can be seen that the calibration is a direct function of the relative cross-sectional areas of the high and low sides of the manometer. The specific gravity of mercury is constant; and since there has been no change in the diameter of the manometer chambers, no change in the length of the float lever should be required to obtain proper calibration. No change in calibration should result from normal service. If the original calibration was accurate, the calibration should remain so. Any apparent change in calibration should be investigated as the possible result of friction, incrustation on the manometer walls, or from foreign material in the manometer chambers. The check valves should be cleaned and adjusted so that they will operate freely. New seat discs should be installed where soft-seated check valves are used. The effect of wear can usually be disregarded in conventional orifice meters, since no motion occurs except when there is a change in flow. Proper calibration requires that the pen arm be of the proper length. Adjustment of the pen arm length so that proper arcing is obtained is a necessity for good calibration and measurement. After the manometer has been cleaned and all maintenance operations have been completed, the manometer should be leveled and the correct amount of clean mercury placed in the manometer.

A recalibration check with a water gage is then made to confirm the accuracy of the device after cleaning and

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Orifice Meter Accuracy . . .

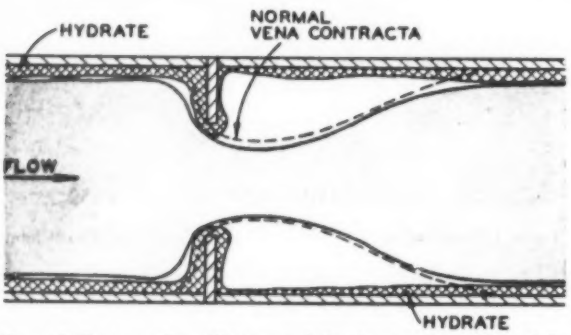


Figure 5. Erroneous flow: Dirt accumulating in meter run and partially obstructing orifice.

maintenance operations. When the manometer is calibrated and properly adjusted, the readings will check a water column perfectly throughout the range of the instrument. A check test beyond the range of the meter will indicate whether the meter is capable of motion slightly beyond full range, thus insuring good measurement up to the one hundred percent scale position. The meter should then be zeroed under pressure. Care should be exercised in manipulating the gage line valves while putting the meter into service or taking it out of service.

The bourdon static pressure element used in gas measurement is as important to the flow calculation as is the manometer. Consequently, too much emphasis cannot be given to the care and calibration which this device should receive. Field calibrations are usually made with either an accurate test gage or with a dead weight tester. Shop calibrations are usually made with a dead weight tester, since it is fundamentally a more accurate reference. When using the dead weight tester, the connections should be arranged so that oil from the tester does not enter the capillary tubing or the helical elements, thereby creating possible obstructions and consequent false readings.

Factors Governing Accuracy—Other factors which influence the accuracy of orifice meters are as follows:

Improper notation on the chart can be a source of very serious error. For example, if a plate has recently been changed on a given application and the chart changer fails to note this change in plate size on the chart, as well as the corresponding change in coefficient, it could lead not only to error but to a great deal of difficulty by the person figuring the chart. As a result, extreme care should be taken to note all the required information as accurately as possible.

Small pits on the upstream face of the orifice plate

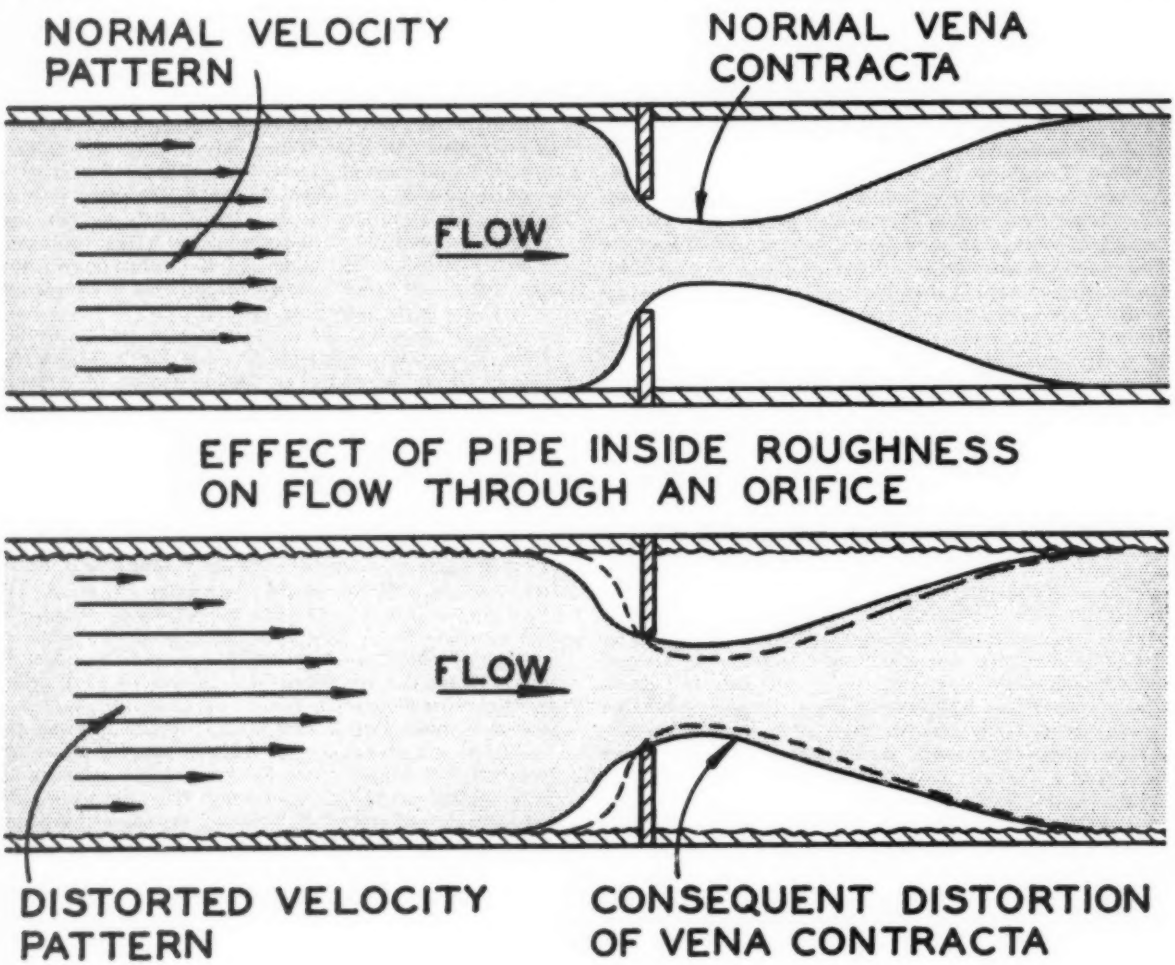


Figure 6. Erroneous flow: Pipe inside roughness.

probably do not make as much error in measurement as is sometimes thought. This is not to be interpreted as a plea, however, for using orifice plates with pitted surfaces since a smooth plate has a more presentable appearance, and measurement with a smooth plate is generally more acceptable. Pits may eventually lead to trouble, particularly if the pits are anywhere near the orifice edge of the plate on the upstream side. They might also permit dust and dirt to cling to the upstream surface of the plate, thereby causing errors in the measurement.

While small nicks on the upstream edge are not to be condoned, these errors are not usually so serious nor of so great a magnitude as those which are brought about when the entire circumference of the hole has a very slight radius on the upstream edge. To be more specific, anything which distorts the entire circumference of the hole in the orifice plate can produce a much greater error than a small nick at one point on the circumference.

Close inspection should be given to the taps—whether flange or pipe taps are used—to see that no burrs protrude into the line, as these obviously can produce eddy currents which may distort the differential pressure and cause error in either a plus or minus direction.

All conventional orifice meters can be furnished with a pulsation dampener or choke. Extreme care should be taken to safeguard against damping the meter too much. In calibrating the meter, one can readily ascertain whether or not the meter has been overly damped by the response to a given differential imposed on the meter as compared to the water column or other reference to which the meter would be connected. Most persons like to see a meter respond to a small change—let us say 10 percent linear change in differential pressure—in a matter of a few seconds. However, a meter can be damped more than this and still be accurate if the changes in flow rate are not too sudden.

Best Pulsating Practice—Pulsating flow is one of the conditions which might lead one to damp a meter excessively. While it is true that a meter record can be smoothed out by pinching down on the pulsation dampener, it does not eliminate the error due to pulsation. The best practice on pulsating flows is, of course, to try to locate the meter at a point as remote from the pulsations as possible. If this is not possible, the effect of the pulsation may be minimized by adding capacity upstream and resistance downstream of the orifice run. In other words, there are times when by the addition of greater capacity—i.e., larger pipe size upstream from the meter run and the insertion of an orifice plate somewhere downstream from the meter run—pulsations can be smoothed out very nicely, although this is not a fool-proof method by any means. The effect of pulsation can in many cases be substantially eliminated by the use of high beta ratios and manometers of higher-than-normal differential range. Such tricks as pinching one or both of the inlet valves on the gage line manifold should never be practiced, since they can lead to extreme errors under certain flowing conditions.

Of course, everything possible should be done to eliminate all leaks on either side of the meter when it is first installed. However, leaks do occur, particularly after a meter has been in service for some time and has been subjected to routine maintenance—during which time the gage lines on the meter may have been subjected to abnormal strains. If the measurement record seems higher than it should be, it is always good practice to look for slight leaks on the downstream side of the meter body, all the way through the gage line piping from the manometer to the tap on the downstream side of the orifice plate. If the meter is reading low, the upstream side should, of course, be correspondingly checked.

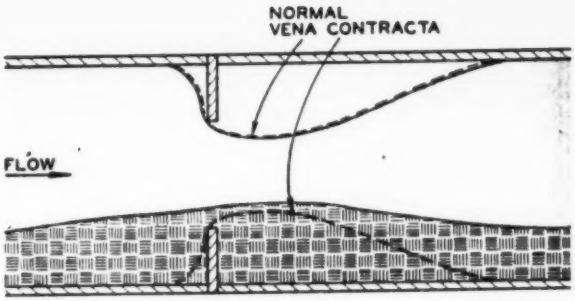


Figure 7. Indefinite flow: Hydrate formation inside meter run and on orifice.

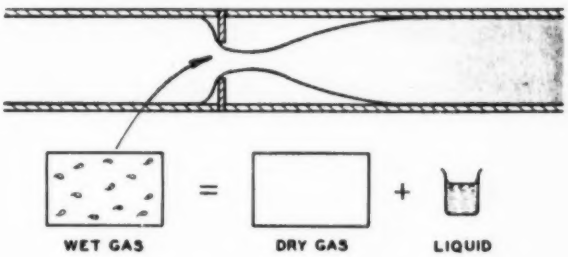


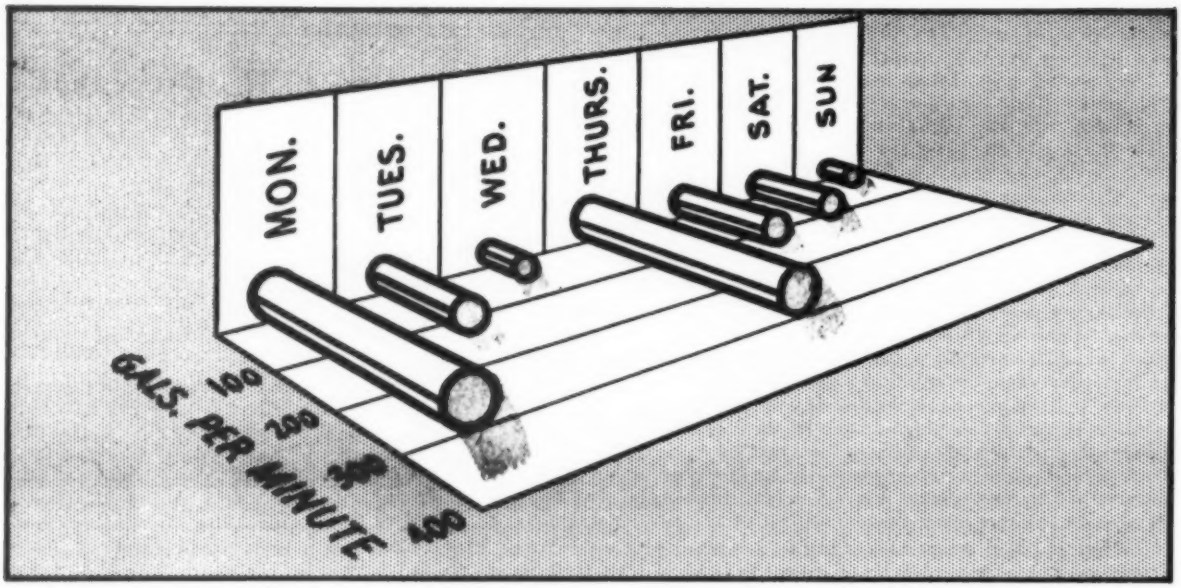
Figure 8. Density: Don't forget the entrained liquid.

Care should also be taken in sizing the orifice plate to keep the meter operating in a readable range. Since the orifice meter is fundamentally limited in rangeability, it is always good practice to size the orifice in such a way that at minimum normal flows the pen reading will usually be above the lower third of the total range. To state this somewhat differently, on a 100-inch meter, it is always good practice to size the orifice in such a manner that at minimum flows a reading of eight inches or more will be obtained. This is due to the fact that the flow varies in proportion to the square root of the differential pressure, and the instrument therefore becomes difficult to read at the lower limits of its range.

Likewise, care should be taken so that the orifice plate is not too small, since too small a plate would create excessive differential pressures, and can cause the meter to go beyond the 100 percent scale range—thus enabling a large quantity of the flowing fluid to be passed which would not be measured at all.

Everything possible should be done to keep the meter in good repair as far as its mechanical operation is concerned. While the orifice meter is a relatively simple device in which no motion occurs except when there is a change in flow, it is still possible to encounter binds and dead spots which can be serious with regard to the total measurement. Faulty operation in this form can best be detected and corrected while running a calibration test on the meter. As every meterman knows, it is always good practice to approach the desired point on the scale from both directions, with increasing and decreasing differential pressures, to see that the meter reproduces the exact reading. When the meter is in over-all calibration—i.e., at zero, mid-scale, and 100 percent—and will satisfy the above test at several different places on the scale, it may be assumed to be relatively free from any binds or dead spots which might tend to hinder good measurement.

Natural Gasoline Issue



First question: How much water do you use daily?

Handbook to . . .

Water Problems and Their Solutions

- Part 1. Water supply and quality
- Part II. Water analysis and interpretation
- Part III. Scale

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Aquatrol, Inc.,
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THE PROBLEM OF water supply includes primarily the factors of quantity and quality. The quantity problem must be solved by equating the answers to the questions: How much is needed? and How much is available? The quality problem is largely one of economics since if an adequate quantity of water is available, the quality can be adjusted to any given set of standards for a price.

The first question "How much is needed" seems simple at first glance. But before a survey can be made of the sources of supply, the demand question must be answered quantitatively. The simplest method of getting this figure is to set down in a vertical column titled "Use" the known uses for the water as determined from data taken from a piping diagram or the water balance of the plant. Other vertical columns should be placed alongside for each quality of water available or required (such as raw, domestic, softened, demineralized, condensate, etc.). Each use then should be extended to show what type of water is needed, the rate needed and the period during which it is used. This will allow an estimate of the average use and maximum demand rate for each quality of water required. Where the demand rate appears excessive, it may be possible to reschedule some operations so that they do not fall at the same time. Since some of the piping and pumps will be sized according to the maximum demand rate, such rescheduling can show real savings. Where connections are made to a municipal supply, the maximum demand rate is sometimes an important cost factor since demand charges are often made by such suppliers. When demand problems cannot be solved by operating schedule changes, it is sometimes possible to plan to use the emergency or standby supply during peak periods.

Is Supply Stable?—To evaluate stability of the supply, some estimate of the effect of the loss of supply or of reduced supply on the over-all economics of operation should be made.

As soon as the question "How much is needed and when will it be needed" is answered, the next question becomes "Is is available?" The detailed problem of water development is a highly specialized field and is usually beyond the scope of duties expected of a plant design engineer. However, the rough outlines and preliminary work are nearly always handled by the design staff.

While seawater and brackish water supplies are sometimes considered for some special cooling problems it is most usual to rely on either underground supplies from wells or surface run-off from nearby streams. These sources can be developed privately, cooperatively, municipally or under governmental authority. Of course the first step in surveying the water supply in an area, is to see what the people already there are doing. Then, additional data is necessary to see if more of the same supply is still available or if the present supply can be improved upon. Information on the quality and quantity of underground supply is usually available from state and government agencies, from consulting hydrologists and from geologists and from contractors who have had wide experience in developing industrial water supplies. These services can also provide information on any legal limitations or restrictions on the development of a private supply. Where water is to be gotten from a supply developed by others, assurances must be obtained that the source is adequate for future needs and that the supplier is willing to provide long-term commitments for supply.

Exploratory Wells Sometimes Desirable—Where the local experience is not sufficient to give reliable information, a test program of exploratory wells may be desirable. Pumping tests on these pilot wells may be required, or it may be sufficient to examine cores and run electric logs in them. With this information, it is usually possible to predict the characteristics of the supply with great precision.

In general, underground supplies are characterized by great uniformity in quality, quantity and temperature. Seasonal variations are not so marked, especially in the deeper strata. The development cost of underground supplies varies widely with depth and the type of formations that must be penetrated. Individual wells cost from $3 per foot of depth in shallow soft formation to $30 per foot for high-capacity wells in deep rock formations. The average cost of industrial wells generally lies in the neighborhood of from $20 to $40 per foot of depth.

Cheap electric power is usually required if operating costs are to be kept down. Maintenance and repair are not unusually big items if the well was properly designed and drilled, and if good pumping equipment is originally installed. The total cost of water delivered, will of course, vary with the cost of the well and the height of lift. Normal ranges in cost of delivered water run from 0.5-50.0 cents per 1000 gallons with an average cost from 1-5 cents per 1000 gallons.

Disadvantages of Surface Supplies—When underground supplies are not desirable because of cost, poor quality or unavailability of water, surface supplies may often be resorted to. For industrial purposes, surface supplies have the drawback of wide variation in quantity and quality, high cost of development and usually the necessity of primary treatment. Many of the existing surface supplies are already completely appropriated or the riparian rights of downstream users forbid adequate development for private use.

In the development of surface supplies, the first step is to find rainfall and run-off data for the stream under consideration. Except in the case of large streams, accurate gaging over extended periods is not usually available. When this is true, run-off must be estimated from information on the extent and character of the drainage area and the past rainfall records.

Where complete data are available over extended periods, reservoir capacity can be simply estimated by the use of a mass diagram. Where it is necessary to use estimated quantities the reservoir is calculated on the average data derived from rainfall and then corrected for size by comparing the average and dry year ratio for the nearest stream in the drainage basin for which data is available. Data of this sort require very large safety factors and the economics of the system suffers accordingly.

If your problem is water SUPPLY . . .

1. Make a detailed water requirement survey showing amount, rate and period of use. Don't forget your long range plans.

2. Examine existing supplies in area.

3. Contact expert advisor (state and government agencies, consultants, experienced contractors).

4. Make long range economic comparison of needs and available sources.

After the requirements of the reservoir are determined, a suitable location must be established, land purchased and cleared, a dam designed and constructed. This cost, $175-$300 per acre foot for reservoirs alone, is so high that not many companies can consider it individually. Such developments usually are carried out as cooperative or governmental projects. The cost of water from such cooperative projects usually compares favorably with underground water, or in some cases, is slightly higher. No single answer can be given to the problem of water supply since variation in individual requirements and local sources of supply are too great. Industry whose economic existence depends on water should rely on detailed requirement studies and expert advice in the development of suitable sources.

IS Water Quality Your Problem?

Having found a supply of water adequate to meet the quantity and rate needs of a plant, the problem of quality must then be considered. This problem can be solved by answering the questions "What is in the water?" "What trouble will these impurities cause?" "How can these undesirable ones be removed?"

The question of "What is in the water?" can best be answered by referring to the analysis of the water. Where a water is liable to be variable in composition (such as a surface water), a series of analyses covering a wide enough span of time to show all the possible variations is required. Where such analyses are not available, it may be possible to resort to analogy with similar streams in the area on which such data are available.

The usual impurities found in a water supply are generally divided into three broad classes—gases, suspended solids and dissolved solids.

The gases most commonly found in water are hydrogen sulfide, carbon dioxide and oxygen. Occasionally, methane is found in freshly drawn well water and ammonia may occur in highly polluted surface waters.

Hydrogen sulfide gives water a foul taste and smell. It can cause corrosion and it can contribute to the chlorine demand of the water. Large quantities can be removed by aeration and small quantities by oxidation with chlorine. If the alkalinity is high, acid addition may be required prior to aeration. Under normal conditions, this treatment should reduce the hydrogen sulfide in the water after treatment to less than 1 ppm.

Corrosion Problems—Carbon dioxide can cause cor-

rosion especially in high-pressure systems or those not containing much bicarbonate to buffer the pH to a fairly high value. Carbon dioxide can be removed by passing the water over an open-tray deaerator or by blowing a stream of air through the water as it stands in a tank. This treatment should reduce the free carbon dioxide to 10 ppm or less.

Forced draft aerators are similar to small wood cooling towers with the exception that they are loaded at the rate of 10-20 gallons per minute per square foot instead of the usual 2-5 gpm per square foot as in the case of cooling towers. Equipment of this type usually costs from $5 to $25 per gallon per minute with the average being around $10 per gallon per minute. The operating cost of these aerators usually is limited to the power cost for running the fan motor and the power of a booster pump if such is required.

Oxygen is the primary cause of corrosion in most water systems, but since it can get back in to the water as soon as it is removed, oxygen removal is carried out only in those waters that will not be exposed to the air again. Oxygen can be removed at ambient temperatures using a vacuum deaerator which is essentially a cooling tower completely enclosed in a steel jacket so that it can be maintained at a reduced pressure. Water may also be heated and deaerated in a similar piece of equipment at atmospheric pressure or slightly above. In either case, complete removal is not affected and the residual oxygen must be removed by the use of a reducing agent such as sodium sulfite. If the sulfite is to be used cold, it should be catalyzed by the addition of about 5 ppm of copper ion.

Deaerating equipment of the common type used on boilers usually costs from $10 to $25 per gallon per minute with an average of $20. The operating cost on this equipment is primarily the cost of steam used to strip the water. Since this steam is usually waste steam and it is recovered as condensate in the feedwater, there is essentially no operating cost.

Methane and ammonia can be removed in the same manner as hydrogen sulfide or carbon dioxide. In the case of ammonia however, it may be necessary to add alkali to raise the pH in order that the ammonia may be released from its combined form. Aeration should leave not more than 1 ppm of either of these materials in the water following treatment.

The suspended solids in the water may be inorganic, dead organic or live organic matter. These materials may cause deposits that will impede the flow of water in the piping or they may aid in scale formation that will interfere with heat transfer.

Oil is one suspended solid that has to be removed.

Removal of Suspended Solids—Coarse suspended solids may be removed by sedimentation. The finer suspended solids may be removed by sedimentation followed by filtration with or without the aid of clarifying chemicals. These clarifying chemicals are usually composed of iron or aluminum which forms gelatinous precipitates under the conditions set up in the treating system and entraps the finely suspended solids (causing them to settle or preventing them from passing through the filters). Under certain conditions, the use of specially designed filters having a precoat of diatomaceous earth may be used to clarify water without the previous addition of coagulant chemicals. Without the use of coagulants, most waters can be reduced to a suspended solids content of 2 to 10 ppm by settling and filtering. By the addition of coagulants, to the process, it is possible to remove the suspended solids down a residual of 1 ppm or less.

If your problem is water QUALITY . . .

1. Get the best data available on the composition of the water and its extremes of variation.

2. Decide what ions need to be controlled and set tolerance limits for these ions.

3. Examine all possible means of achieving these tolerance limits and make an economic comparison.

Pressure filters filled with sand or anthracite coal cost from $20-$75 per gpm with an average of around $35. The major operating cost on filters is the head loss which may be made quite small and the water lost during the backwashing operation which may amount to 1 to 10 percent of the water fed to the filter depending on the suspended solids load. The use of a coagulant followed by filtration is quite satisfactory as a method of removal. There is another method, however, in which the oil-containing water is passed through a bed of crushed anthracite coal that serves to coalesce the finely divided oil particles into larger drops. Final removal takes place in a skimming tank.

There are a number of soluble materials which may be found in a water supply, but only those items that are of industrial significance will be discussed.

Alkalinity in the form of bicarbonates, carbonates, or more rarely hydroxides are usually found in most water supplies. These materials promote boiler foaming. They decompose and release CO_2 into the steam which causes condensate return line corrosion and boiler embrittlement.

The best way to remove these materials is to pass the water through a hydrogen cycle cation exchanger and remove the cations associated with them, substituting an equivalent amount of hydrogen ion. This will neutralize the hydroxide and leave the carbonate and bicarbonate in the form of carbonic acid which can be easily removed by aeration. The simplest way to remove alkalinity from the water is to add a free acid but this process has the difficulty that the water has not had its dissolved solids content reduced, but merely has had the solids changed from one form to another. The carbonates and bicarbonates may also be removed by the treatment with lime, either in the hot or cold process softener. Under certain cases, the use of gypsum is also required to complete the alkalinity removal.

The Problem of Chlorides—Chlorides in industrial water supplies can cause trouble in boilers by raising the total dissolved solids content to the point that foaming and corrosion occur. The only economically sound method of removing chlorides from industrial water other than distillation, is by anion exchange using a strong base synthetic resin zeolite. A properly designed anion exchanger should leave less than 3 ppm of chloride in the finished water.

The equipment for anion exchange is somewhat more expensive than for cation exchange because the exchange materials used cost approximately three times as much as the cation exchangers. The anion exchangers in general have somewhat lower capacities, thus requiring a larger unit for the same number of equivalents removed. In general, anion exchangers cost from $30 to $100 per pound of anion removed (as $CaCO_3$). The chemical cost for opating anion exchangers that are regenerated with caustic

varies rather widely in the range from 3 to 15 cents per pound of anion removed, with an average of about 7 cents per pound of anion removed.

Sulfates are one of the sources of heat transfer impeding scale deposits in cooling systems and under certain conditions, they can also form scale in boilers. Where the water is to be used for domestic consumption it should be noted that large quantities of sulfate can cause purgative action and it causes the water to have a bitter taste. While it is possible to remove sulfates by treating it with soluble barium salts to form the insoluble barium sulfate, this method is not often used today because of the expense of the barium salts and because of their high toxicity. Like the chloride ion, the sulfate ion may be removed by passing it through a strong base synthetic resin zeolite bed which should leave less than 3 ppm of sulfate in the finished water.

TABLE 1
Check List for Water Impurities

Impurity	Formula or Symbol	Undesirable Effects	Usual Limit or Tolerance	Method of Correction	Residual After Treatment
Hydrogen Sulfide	H_2S	1. Odor 2. Corrosion 3. Chlorine Demand	<0.5 ppm	Aeration	<1 ppm
Carbon Dioxide	CO_2	Corrosion if alkalinity is low.	Alk / CO_2 >3	Aeration	5-10 ppm
Oxygen	O_2	Corrosion	<0.007 ppm in boilers & economizers	Hot Deaeration	<0.007 ppm
				Cold Vacuum deaeration	0.1-0.3 ppm
Suspended Solids		1. Impeded water flow 2. Retards heat transfer		Sedimentation & Filters	<5 ppm
		3. Aid corrosion	<5 ppm	Plus coagulant chemicals where necessary	<1 ppm
		4. Soils products (paper, textiles)			
Oil		Causes sludges to bake on in form of scale. Causes boiler foaming	1 ppm / 7 ppm max.	Coalescing followed by skimming	5 ppm
				Absorption with preformed floc followed by filtration	<1 ppm
Alkalinity	HCO_3	1. Promote boiler foaming	For boilers	Cation exchange (hydrogen cycle)	as desired residual
	CO_3 or OH	2. Forms CO_2 in steam causing condensate corrosion	300 ppm conc. ratio	Sulfuric Acid addition	
		3. Causes boiler embrittlement			
		4. Causes cracking in ice	For ice		
		5. Affects taste	30-50 ppm For drinking	Lime with or without gypsum	not less than 60 ppm
		6. Interferes with pH control	<300 ppm		
Chlorides	Cl	1. Boiler foaming 2. Corrosion	Generally 100-300 ppm max. where possible	Anion Exchange	<1 ppm
Sulfate	SO_4	1. Scale formation 2. Purgative 3. Bad Taste	100-300 ppm max. Where possible	Barium Treatment	17-25 ppm
				Anion Exchange	0-3 ppm
Silica	SiO_2	1. Scale 2. Turbine deposits	3-20 ppm depending on boiler pressure	Adsorption on $Fe(OH)_3$ or $Mg(OH)_2$	
				anion exchanged with or without fluoride addition	0.10-0.30 ppm
Iron & Manganese	Fe or Mn	1. Corrosion 2. Scale 3. Taste	0.3 ppm	Aeration followed by filtration (pH control may be required)	0.1-0.3 ppm
		4. Color products		Deionization	
Calcium	Ca	1. Scale formation	Generally 60-80 ppm for process use & boilers 0-10 ppm max.	Cold Lime Soda	25-35 ppm
				Hot Lime Soda	12-15 ppm
				(Sodium or Hydrogen cycle) cation exchange	0-5 ppm
Magnesium	Mg	Scale formation	Generally 60-80 ppm	Same as Ca	same as Ca
Sodium	Na	Boiler foaming corrosion	as low as possible	cation exchange (hydrogen cycle)	0-5 ppm

Fluorides sometimes occur in small quantities in natural water supplies, but because of the low solubility of the calcium fluoride it is unusual to find significant quantities of fluoride in natural waters.

Chromium salts are not normally found in naturally occurring waters unless they are there as a result of polution from waters previously treated with a corrosion inhibitor or which contains waste from a plating plant.

Phosphates do not normally occur in natural waters because of the comparative insolubility of the calcium salts.

Nitrates and nitrites are sometimes found in surface waters which have been subjected to organic polution but they have little effect on the use of the water industrially. The presence of considerable quantities of nitrate or nitrite in the water should act as a danger signal to the user so that he may investigate the possible sources of organic pollution.

Troubles Resulting from Silica Silica can be a very troublesome contributor to scale formation in boilers or industrial cooling systems since the scales laid down are very resistant to removal by most normal means. Silica can also cause severe blade deposits in turbines operating on high pressure steam from boilers which are fed with water containing appreciable quantities of silica. These latter deposits are usually found in turbines fed with steam from boilers operating at 550 psi or higher. The silica is carried over in the form of gaseous silicic acid. Silica can be removed in lime soda softeners by the addition of magnesium salts which adsorb the silica. Ferric hydroxide also has the property of adsorbing silica though not to the extent of the magnesium compounds. Under optimum conditions, silica may be removed by these processes to a residual of 5 ppm or less. Silica may also be removed by strong base anion exchangers either with or without the addition of fluoride ions. Ion exchange can remove silica to a residual of less than 1 ppm.

Iron and manganese can contribute to corrosion and scale formation. The first step in the removal of these compounds involves their oxidation to the higher valence state by adequate contacting with air. The higher valence state of both materials forms hydroxides that are very insoluble and easily removed by filtration. After the oxidation process has been carried out, a pH adjusting reagent is added to the water. When coagulation of the precipitated hydroxides occurs, the water is filtered for their removal. Under proper operating conditions, this treatment should leave a combined residual of iron and manganese less than 1 ppm.

Aluminum ions are sometimes found in natural water supplies or in waters which have been treated with aluminum salts to aid in the removal of suspended solids. These materials usually contribute to the formation of troublesome scale. Aluminum compounds are not difficult to remove since the solubility of the hydroxide is quite low. Usually it is sufficient to raise the pH of the water, allow adequate time for coagulation of the precipitated aluminum hydroxide and filter. Such treatment usually reduces the aluminum content of the water to less than 5 ppm.

Calcium Another Scale Offender Calcium salts are widely distributed in natural waters and are one of the chief offenders in the formation of scale deposits in in-

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dustrial equipment. This is true since many of the calcium salts have inverted solubility curves, (i.e., these materials are less soluble in hot water than in cold water). Calcium compounds may be removed by the addition of lime and soda ash either in the cold or in hot process softeners. Because of the inverted solubility of calcium carbonate, it is possible to remove the calcium salts only to approximately 25-35 ppm in cold process equipment. In hot process equipment the lower solubility of the calcium salts makes it possible to reduce the residual calcium in the treated water to approximately 12-15 ppm. Calcium compounds may also be removed by cation exchange either in the sodium cycle or the hydrogen cycle. In the sodium cycle, the calcium ions are replaced by an equivalent quantity of sodium ions, and in the hydrogen cycle by an equivalent quantity of hydrogen ions. The residual calcium, after having been treated in a cation exchanger, should not exceed 5 ppm and under proper conditions may be reduced approximately to zero.

Magnesium follows many of the calcium salt reactions except that its main position as an offender lies in its ability to adsorb silica as it precipitates in the form of magnesium hydroxide. This leads to the formation of magnesium silicate scales which normally do not adhere. However, when bound by small quantities of oil or other binding agents, they can form a very troublesome scale. The magnesium ions are removed in the lime-soda softeners in the form of the hydroxide. In the hot process, magnesium salts may be reduced to 7 ppm or lower; in the cold process, magnesium residuals may rise as high as 20 ppm, depending upon the pH and hydroxide ion concentrations available for precipitation.

Hot lime soda softeners cost on an average of $60 to $120 per gpm with an average figure of around $100. Cold lime soda softeners usually run from $100 to $175 per gpm with an average of around $130. The operating cost on this equipment is fairly high since they usually require the attention of one man on each shift in addition to the lime cost which approximates 0.7 cent per thousand gallons for each 100 ppm of alkalinity plus magnesium (both as $CaCO_3$), soda ash 3.4 cents per thousand gallons for each 100 ppm of hardness minus the alkalinity or if the alkalinity is greater than the hardness, gypsum at 1.5 cents per thousand gallons for each 100 ppm alkalinity minus the hardness.

Cation exchangers operating in the sodium cycle usually cost from $10 to $20 per pound of hardness removed and require from 1 to 2 cents of chemicals per pound of hardness removed. When operating in the hydrogen cycle, corrosion resistant equipment is required and the chemical cost is somewhat higher since the efficiency of most exchangers with sulfuric acid is somewhat lower than that with salt. Hydrogen cycle exchangers usually cost from $15 to $40 per pound of cation as $CaCO_3$ removed (averaging about $20 per pound). The chemical cost for sulfuric acid runs from 1 to 4 cents per pound of cation removed (as $CaCO_3$) with an average of 3 cents per pound. The operating cost varies quite widely with the sodium content. The chemical cost goes down as the percentage of sodium ions goes up.

Removal of Sodium Ions—Sodium ions are widely distributed in all forms of natural waters, both underground and surface supplies. Since they do not normally form insoluble salts, they cause no particular trouble except they contribute to the total solids content. The only good method of removing sodium ions from the water is cation exchange in the hydrogen cycle, wherein the sodium is replaced by an equivalent quantity of hydrogen ions. Under ideal conditions, the sodium ions can be reduced approximately to zero by this method; but in many cases, it is economically desirable to allow a considerable leakage through the exchanger.

There are several other ions which may be found in natural water supplies that normally have little industrial significance. Bromide ions are found in certain underground supplies but since they occur in relatively small quantities and are detected by the usual method of chloride determination, they are not usually reported separately. In like manner, potassium ions may be found in natural water but unless the water is to be used for some specific purpose requiring the absence of potassium salts they usually are reported as equivalent quantities of sodium. Certain sub-surface waters also contain considerable quantities of barium salts. These are normally of little significance unless the water is to be used for domestic consumption or mixed with other water supplies containing sulfate ions. The potassium and barium salts are usually detected by spectrophotometric procedures and if their removal is required, specially designed ion exchange equipment is utilized.

The effect of total dissolved solids on the formation of foam in boilers is probably due to the effect of the high ionic strength on the surface tension of the water. Very stringent boiler recommendations require that the maximum total dissolved solids content in the boiler not exceed 3000 ppm. Many boilers, especially in the southwestern part of the United States, must be fed with water whose solids content exceed this value before it is concentrated by evaporation.

The total dissolved solids contribute to the corrosion process since the saltier the water the better it will conduct currents, and in many cases, the internal resistance of the electrochemical cells is one of the limiting factors in the corrosion rate. It has been definitely established in certain industrial systems that the corrosion rate is directly proportional to the total dissolved solids content of the water.

The pH of the water supply is largely a reflection of its alkalinity, total dissolved solids content and temperature. At pH's below 6 accelerated corrosion is likely to occur and at pH's above 11 the corrosion rate diminishes quite rapidly. In oxygenated systems whose pH lies between these two values, the pH has relatively little effect on the corrosion rate although certain theoretical considerations indicate that the corrosion rate should rise slightly with increasing pH values.

As to Prices Cited—The prices quoted for equipment cost and chemical cost are broad ranges for orientation purposes only. No effort has been made to indicate whether these prices included freight to the site and no effort has been made to correlate them with any cost index, since many variables cause these cost estimates to be so broad that attempts at precision have no significance. All of the cost data have been derived from actual bids on one or more pieces of equipment in a normal industrial size range. In general, the smaller equipment is more expensive per unit of capacity and most cases, increases in cost according to the so-called 0.6 rule (which states that the ratio of cost of two pieces of equipment of the same type but different in size varies as the 0.6 power of the ratio of their sizes).

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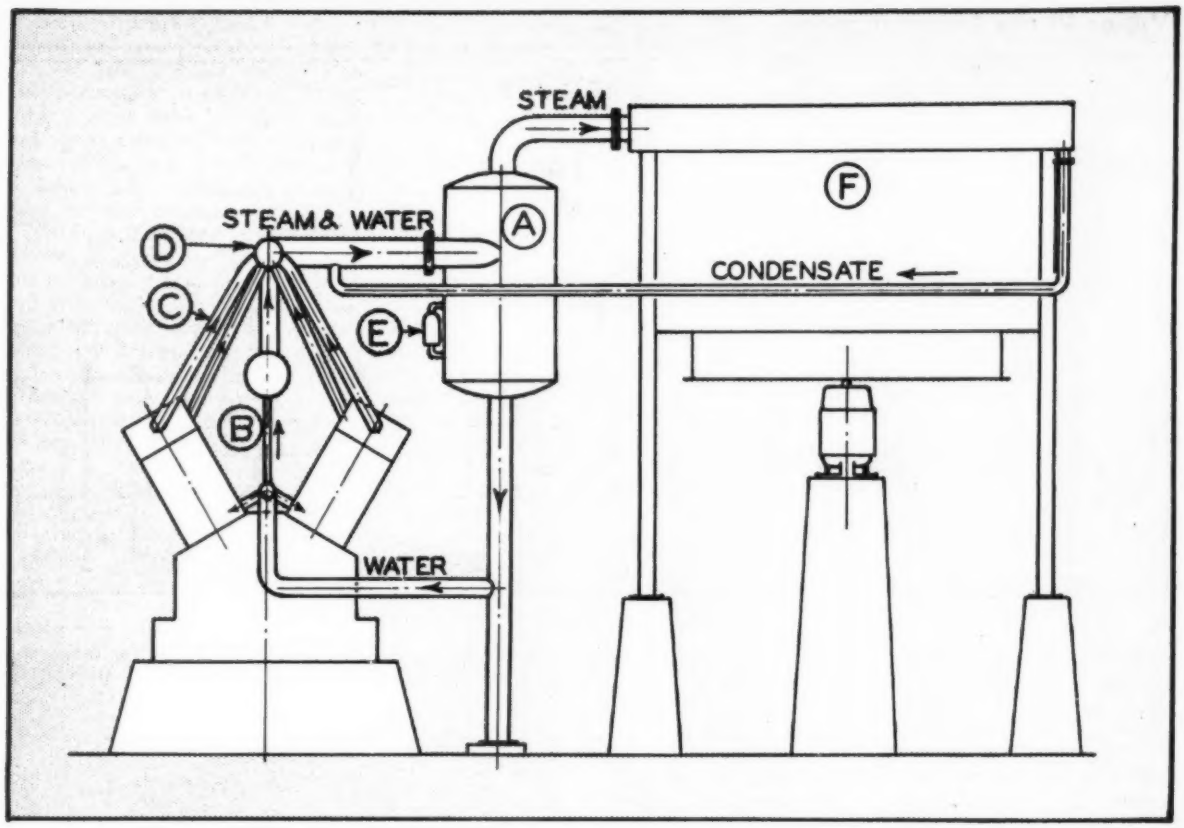

Figure 1. Vapor phase unit with thermal circulation cycle.

Have you considered . . .

Vapor Phase Engine Cooling

- Inherent temperature control
- Reduced engine wear
- No circulating water pumps
- Cheap steam supply

Lloyd C. Harbert,
Engineering Controls, Inc.,
Los Angeles

ENGINE JACKET cooling is experiencing a revolution in California. The method, termed "vapor phase cooling," utilizes water at its boiling point, thus taking advantage of the large latent heat of vaporization in preference to sensible heat realization in conventional systems. The steam so produced can be put to convenient use.

Actually the method has been in use since 1939 but it has not been until the last few years that great strides have been made to increase its scope to the 250,000 bhp of gas and diesel engines now so equipped.

The revolution does not end here. Another development, termed "thermal circulation," eliminates the circulating water pump in the system. No new method either, this alternative merely permits natural circulation of the coolant and has been variously known as thermo-siphon, cooling by ebullition, and boiling point cooling.

Thermal Circulation Cycle—Figure 1 shows the system connected to the power cylinders of a large gas engine driven compressor. Two circuits are employed. The primary circuit, being the coolant, flows out of the vapor phase unit "A" through the engine jackets and back, repeating the cycle. Upon first starting the engine and until it has run for several minutes, there will be no movement of the coolant. When sufficient heat has been

Natural Gasoline Issue

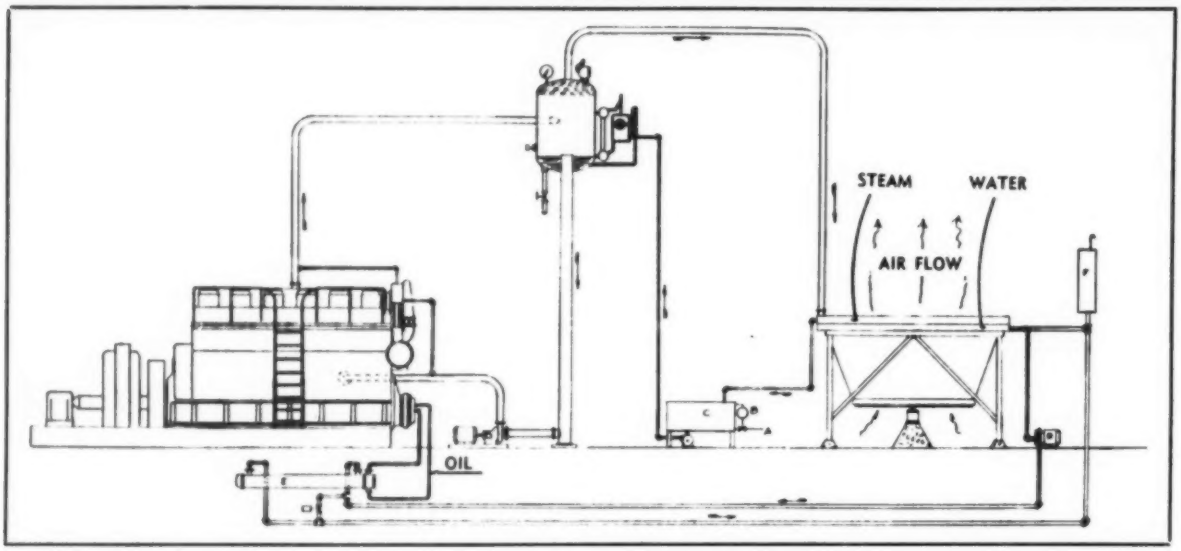

Figure 2. Vapor phase unit with engine driven water pump.

rejected, ebullition will commence in the cylinder head and the upper part of the cylinder jacket, starting circulation. As load is applied, circulation will increase, in direct proportion to the load. Under full load, some ebullition will occur, as low in the cylinder as the end of the piston stroke and will increase in intensity as the water, carried along with the steam, passes upward around the combustion chamber and the water cooled exhaust manifold, much the same as it does in a water tube boiler or a pan of boiling water when the flame is turned up.

The water and steam enters the vapor phase unit tangentally, causing it to swirl around inside. Any scale or foreign matter in the coolant is thus thrown down in the mud drum built in at the bottom of the unit, where baffles arrest the swirl and trap the solids, which are then drawn off by blow down.

The steam separator, built in at the top of Unit A, dries the steam, which passes through the secondary circuit, being a steam condensing coil in Unit F. This unit also contains a water coil for lube oil cooling. The steam condensate returns to the primary circuit at the point shown. The condensate may at times, be sub-cooled, therefore it is desirable to have it enter as near "D" as possible so it will be heated to boiling before it enters Unit A.

Piping for Thermal Circulation—As considerable steam will form in the engine jackets, somewhat larger outlet lines are required. It is imperative that the system be so piped as to insure the inlet leg, solid water, being heavier than the outlet leg of water and steam, to insure a minimum of restriction. The inlet water header is tapped and a small line installed to carry water to the exhaust manifold "B". Usually, though not always, an auxiliary line "C" is required to pass all water and steam out of the cylinder and head. An additional pipe manifold "D" is installed above manifold "B," where the auxiliary line "C" and the one supplied with the engine are tied in. By separating the flow through the exhaust manifold "B" from the jackets, a free flow through all parts is obtained.

Unit A is mounted low, the bottom of the unit being even with the top of the water jacket. The low water switch "E" being positioned so that when the water level in the Unit falls to unsafe level, the engine will shut down while the jackets are still full of fluid.

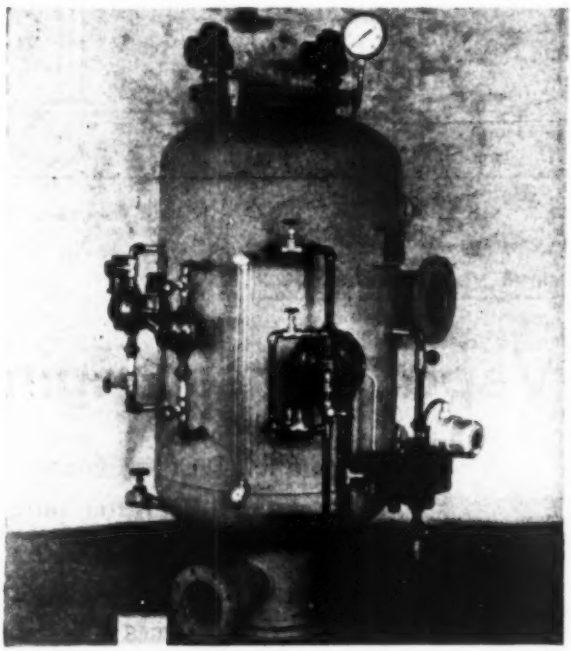

Figure 3. Special controls for vapor phase units.

Where the steam condenser can be mounted at the height shown and when the condensate header of the steam condenser is at least 24 inches above normal liquid level in Unit A, the condensate will flow back to the primary circuit by gravity. Unit A is normally supplied with a pressure relief valve, pressure gauge, air vent valve, gauge glass and an automatic fresh water make up valve, in addition to the low water float switch.

Circulating Rates—The rate of water circulated in a vapor phase-thermal circulation system is essentially the

same as that of a water tube boiler and is approximately as shown in Table A.

The amount of steam generated in the engine, depends upon its type, size and load. A naturally aspirated, four cycle gas engine, requiring 10,000 btu input per bhp will produce about three pounds of steam per bhp/per hour. The rate of water required, at full load, to cool a 1000-bhp engine of this type, will be about 3 pounds steam per bhp per hour or, 3000 pounds of steam per hour x 18 pounds water to 1 pound steam = 54,000 pounds water per hour or, 108 gpm. This represents 0.108 gpm of water per bhp. In order to cool the same engine in the liquid phase, 600 gpm of water would be required, in order to obtain a 10-degree temperature rise across the engine, because each pound of water circulated will absorb only one btu per pound, per degree temperature rise, whereas in thermal circulation only a small percent of the heat is removed as sensible heat, the greatest portion being absorbed by the coolant as latent heat. This means much smaller, and less expensive lines. While the outlet water and steam line, running to the vapor phase unit, is larger than required for conventional cooling the inlet line from the Unit, to the engine, can be much smaller. The steam line from the vapor phase unit to the steam condenser for a 1000-bhp gas engine will require an 8 inch line and the steam condensate, being only 6 gpm, will require a $1\frac{1}{2}$ inch line.

Lube Oil and Lube Oil Cooling—Where dry type pistons are used, lube oil cooling is not required with vapor phase. Where oil cooled pistons are used the lube oil must absorb about four to five times as much heat, therefore, it must be cooled.

High grade lube oils, of the straight mineral type, are adequate for all gas engines cooled by vapor phase. Engine metal temperature, surrounding the combustion chamber, in many engines tested, are no higher than in engines conventionally cooled. Since any engine cooled at temperatures above the dew point, (194 degrees F., minimum metal temperature) no condensing of the water from the products of combustion can be formed within the cylinders, thus acid formation is eliminated, because acid can form only in the presence of moisture, regardless of the amount of H_2S contained in the engine fuel. Therefore, heavy duty lube oils are not usually required.

Heating of Idle Engines—Where individual vapor phase units are desired, for several engines in one station, so that each engine cooling system may be moved with the engine to another location, it will be necessary to install a steam equalizing line, connecting all vapor phase units at the top, and a water equalizing line, connecting all water inlet lines at the bottom. When so interconnected all idle engines are maintained warm, at about 200 to 210 degrees F., with the steam from the operating engines. The steam flows down the individual engine outlet water and steam line, which contains no water when idle, heats the water in the top of the engine, by condensing the steam, as the condensate builds up, the heated water will flow in reverse through the water equalizing lines to the other operating vapor phase units. By this method, the normal water level in both the operating and the idle units is maintained. Where one vapor phase unit is used to serve two or more engines, equalizing lines are not required. For large engines, individual vapor phase units are desirable because the size of a central vapor phase unit to serve two or more engines, becomes quite large and the inlet and outlet header lines must be increased in size.

TABLE A

Percent of Engine Load	Steam-Water Ratio
25	90 Pounds of water to each pound of steam
50	50 Pounds of water to each pound of steam
75	27.5 Pounds of water to each pound of steam
100	18 Pounds of water to each pound of steam

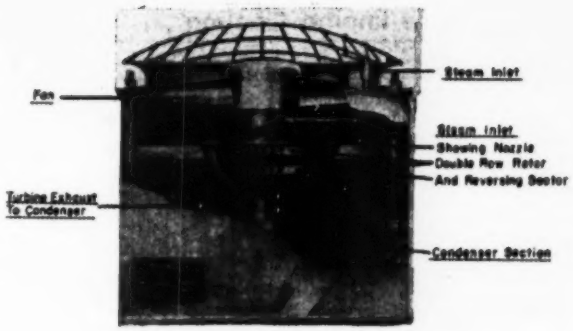

Figure 4. Steam turbine-driven fan condenser.

Make-up Water—Vapor phase systems require practically no make-up water except to replace leaks. By the use of high heat resisting cylinder liner and sealing rings, grommets, gaskets and flexible connections, of the plastic type, water leaks can be greatly minimized. If the available make-up water is soft, no scale will form in the engine. If hard, it must be treated to remove the scale forming properties. The engine, like a boiler, must be supplied with good water. If treated water is used, the vapor phase unit must be blown down to remove the solids, in suspension, in the treated water.

The use of the plastic seals, where required, in the engine and in any flexible joints in the piping should be used instead of rubber. High grade plastic material, of the silicone type, that will withstand high temperatures add very little to the overall cost of the engine installation, therefore, they are recommended over the plain rubber which, in hot water and steam will lose its elasticity, harden and soon cause leaks.

Fuels—In some oil refineries, natural gasoline plants and petrochemical plants, considerable fuel is available that contains H_2S. Such fuels, if the H_2S content is high, are mixed with sweet gas and burned. This fuel can be used safely with vapor phase, without causing accelerated engine wear, because this gas cannot cause acid formation when cooling at the elevated temperatures. Many vapor phase cooled engines have operated for years with untreated sewage sludge gas, oil field and refinery sour gas, all containing a high percentage of H_2S. Also diesel engines, operating on fuel oils containing as much as 3 percent sulphur.

Antifreeze Solutions—In mild climates where freezing temperatures are occasionally encountered a portion of the steam condenser should be covered so as to prevent freezing of the condensate. Where hydraulic type or two speed motor driven fans are used, they can be slowed down during cold weather.

In very cold climates the steam condensers should be mounted in a lean-to alongside the engine house. Cooling air may be drawn from inside the engine house and discharged outside through louvers in the lean-to. Another set of louvers installed in the wall of the engine house will

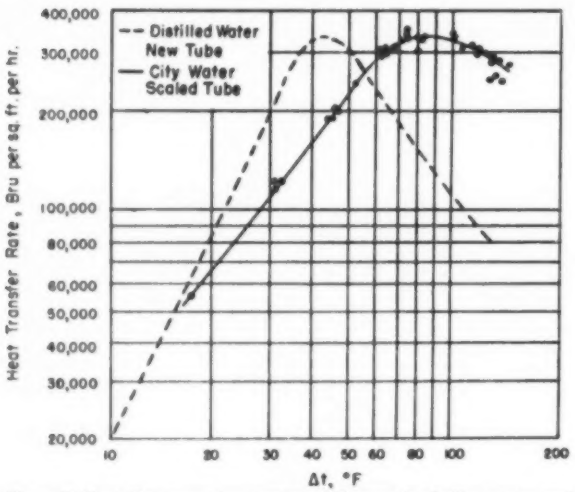

Figure 5. Heat flux versus temperature difference for boiling water and a heated metal surface.

permit heated air to discharge back into the engine house for heating.

Engine Room Temperature—Are engine room temperatures excessively high with this installation? The greatest quantity of heat radiated to the engine room, by a gas engine, comes from the exhaust line which should be insulated in all cases. Insulation of the vapor phase unit, all hot water and steam lines is also recommended. When this is done the engine room temperature will not be excessive. The room temperatures in Table 1 were observed in a gas engine compressor station, where several large engines were operating at 212 F. jacket temperature, with only the exhaust line insulated.

First Cost—The cost of the equipment, including the vapor phase unit, steam condenser unit, with water coil for cooling lube oil, fan and drive is competitive for engines in the range of 500 to 750 bhp. The same equipment is usually less expensive for larger engines. Where hydraulic or electric driven fans are used considerably less cooling air is required due to the elevated temperature, thus fan horsepower is saved.

Vapor Phase Pump Circulation—Figure 2 shows the vapor phase unit, which must be mounted high enough above the engine, to insure a positive head on the circulating water pump. As the aerial cooler may not, in most cases, be mounted high enough for gravity return of the condensate, the Condensate Unit C is required, making a more expensive installation.

Special Controls—Figure 3 shows a unit which is designed for unattended engines and where a condensate return unit may be required because the steam is being used in a heating system that is below the vapor phase unit.

The highest float switch, shown at the left, controls the condensate pump. The next lower one controls a standby condensate pump. The next one is the automatic fresh water make-up float valve. In case of failure of both condensate pumps and, at the same time, failure of the fresh water supply, the next float switch will sound an alarm or actuate a signal in the office upon lowering water level. If the cause of the failure of the condensate pumps and fresh water supply is not corrected, the float switch, located below the alarm switch, will ground all engine magnetos, thus stopping the engine.

Steam Turbine Driven Fan—Several years ago we conceived the idea of utilizing the vapor phase steam to drive fans with turbines, thereby cooling engines with their own waste heat.

Shown in Figure 4 is the turbine unit which is complete with fan and a finned coil for condensing the steam. The turbine will automatically start turning the fan as soon as steam is produced. As engine load increases the turbine speeds up, always supplying the correct quantity of cooling air for all engine loadings. When the engine is shut down the turbine does not stop until all residual steam is condensed. During the hot part of the day the turbine will build up about 15 to 20 psig pressure, at full engine load, the pressure reducing to about 5 psig at night or during low load periods. As the steam leaves the turbine it enters the condenser at atmospheric pressure, requiring a condensate pump.

Research—Investigation of heat-transfer with water at boiling temperature explains why even at low coolant velocities a high heat-transfer takes place. The heat-transfer rate at various temperature differences between a heated metal surface and boiling water is shown in Figure 5.

The graph shows the important fact that the heat-transfer rate under boiling conditions depends almost entirely on the temperature difference between the hot metal surface and the boiling point of water. The boiling point of water depends of course on the pressure at which the water flows past the particular location in the cylinder or cylinder head.

In vaporizing, far more heat is abstracted from the metal surface than would otherwise be possible, and an extremely high heat-transfer rate is obtainable with relatively little difference in temperature between the water

TABLE 1

Engine Room Temperatures

LOCATION	Temperature, F.
Ambient Air	84°
6" from power cylinder 30" above the floor	97°
8" from power cylinder 30" above the floor	96°
72" from power cylinder 30" above the floor	95°

TABLE 2

Cylinder Wall Temperatures (F.) for Conventional and Vapor Phase Cooling

Cooling System	Water In	Water Out	Cylinder Wall Position 1	2	3	4
Conventional	148	154	231	220	205	190
Vapor Phase*	206	213	270	261	244	233
Vapor Phase**	209	214	219	217	220	218

* With water pump.
**With thermal circulation.

TABLE 3

Inspection Measurements of 11-Inch Bore Cylinders

CYLINDER		Top ¾"	Middle 5"	Bottom 10"
No. 1	A.*	11.011	11.0015	11.002
	B.*	11.001	11.000	11.000
No. 3	A.	11.00025	11.99925	11.000
	B.	11.0005	10.999	11.000
No. 3	A.	11.001	11.000	11.000
	B.	11.001	11.000	11.000
No. 6	A.	11.001	11.00075	11.001
	B.	11.003	11.00475	11.007

*"A" is parallel to crank shaft while "B" is at right angles to the crank shaft.

and the metal surface. The small vapor bubbles formed leave the metal surface, mix with the surrounding water and condense unless the entire body of the water is at boiling point as in a pan of boiling water.

The excellent wetting action of the water coupled with its high latent heat of vaporization make it an exceptionally good coolant for this type of cooling.

Cylinder Wall Temperatures—Comparison of metal and water temperatures does not show a significant difference between conventional and vapor phase cooling systems. Typical results are shown in Table 2. The diesel engine used in the first two systems was a naturally aspirated, four-cycle engine with a rated 150 bhp and circulating water rate of 0.7 gpm per bhp. Four thermocouples were sealed in the cylinder metal (on the water jacket side), the No. 1 position being at the top and the No. 4 being at the bottom. It will be noted that the temperature difference between the No. 1 position and the water out is 77 F. for the conventional system and 57 F. for the vapor phase systems with a water pump. In the case of the vapor phase system with thermal circulation, the difference is only 5 F.

Corrosion—Cylinder wear is less at temperatures above the dewpoint as will be noted in Figure 6. In fact the rate of wear is shown to be almost independent of temperature over the range from 212 to 510 F.; but below a temperature of 194 F., there is a rapid increase in rate of wear. This phenomena works to the advantage of vapor phase cooling (operating above the dewpoint) as is borne out by the typical field results shown in Table 3. This inspection data was taken on four power cylinders of an 11-inch bore gas engine-compressor, after 5800 hours of operation. Further, it was observed that the pistons and firing chambers were unusually clean. Adjustment and maintenance time on this unit and two similar ones average approximately 30 percent less than the average unit time spent on all other engine units in this plant that are equipped with conventional cooling systems.

Waste Heat Recovery—The amount of heat recoverable from the jackets of a modern gas engine driven compressor unit such as those in oil refineries and in gasoline plants is, in the order of, 2500 Btu per bhp per hour. From older style gas-compressor units as much as 3000 Btu per bhp per hour is recovered. This heat, in the form of steam, at 20 psig (258.8 F.) is being used in two gas compressor plants in California to treat crude oil. The heat is recovered from one 150-bhp and three 300-bhp gas engines in one station and from one 150-bhp and seven 300-bhp gas engines in the other one. Both have older style engines that consume on the order of 10,000 Btu per bhp per hour.

A temperature control valve, installed in the heated oil outlet line, operates a motor valve to regulate the flow of steam. When the steam pressure builds up to 22 psig the back pressure valve leading to the turbines will open and pass the steam to the turbines, which automatically start and stop the fans.

Where additional waste heat is required, (not required in these stations) an additional 1500 Btu per bhp per hour can be recovered from the exhaust as steam at low pressure or, if required, about 1000 Btu per bhp per hour can be recovered as steam at pressures up to 125 psig.

The quantity of heat recoverable from an engine depends upon the efficiency of the engine. Supercharged engines, that consume 6500 Btu per bhp per hour will produce less than 1000 Btu per bhp per hour from the jackets.

If all steam recovered by the vapor phase system can be used and the condensate returned to the primary circuit, a closed engine cooling system will result, thus eliminating the necessity of providing standby steam condensers. If the process cannot use all of the steam, then the excess steam may either be discharged to atmosphere or standby condensers can be installed if ample soft water is not available for make-up.

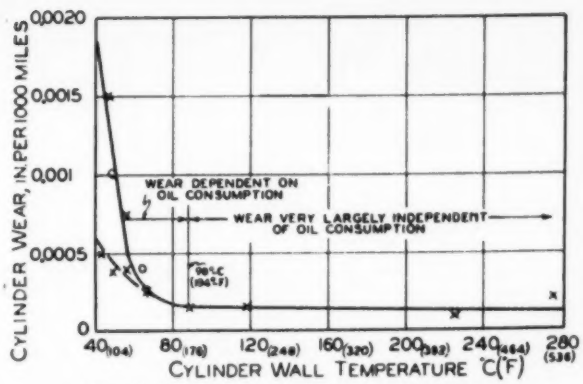

Figure 6. Cylinder wear in relation to wall temperature.

It is important to remember that all heat rejected to the circulating water is recoverable in its more useful form, i.e., low pressure steam; and all of it can be used without lowering the temperature of the circulating water below boiling.

Advantages of Vapor Phase Thermal Circulation—(1) Temperature control at all loads is made automatic by the natural law of boiling of the coolants. Thermostats and all other mechanical controls are eliminated.

While the coolant boils all of the time the engine runs, it cannot boil over. As circulating of the coolant cannot commence until it boils, the warm up period is much shorter. Where two or more engines are being cooled, idle engines can be maintained at near boiling temperature indefinitely. Such idle engine can be started and be placed under full load as soon as the lube oil pressure reaches operating level.

(2) Constant temperature, at all loads, is always above the dewpoint of gases, therefore, the water of combustion cannot condense on the cylinder walls, thus acid formation is eliminated, resulting in:

(A) Gas fuel, containing H_2S, or fuel oil containing sulphur, all of which are cheaper, can safely be used.
(B) Cylinder wear, caused by corrosion, is greatly reduced.
(C) Lube oil sludge minimized.
(D) Improved combustion.
(E) A very turbulent flow of water and steam through the jackets.

(3) Circulating water pumps are completely eliminated. Likewise their maintenance and cost of power to drive them.

(4) Proper circulation of water at all loads is automatically controlled by the heat being rejected.

(5) Even expansion of all engine metal, resulting in improved cylinder-piston clearance.

ACKNOWLEDGMENTS

[1] W. H. McAdams, Heat Transmission, McGraw-Hill, New York (1933).
[2] Williams, "Collected Researches on Cylinder Wear," Institute of Automotive Engineers, January, 1919.

Natural Gasoline Issue

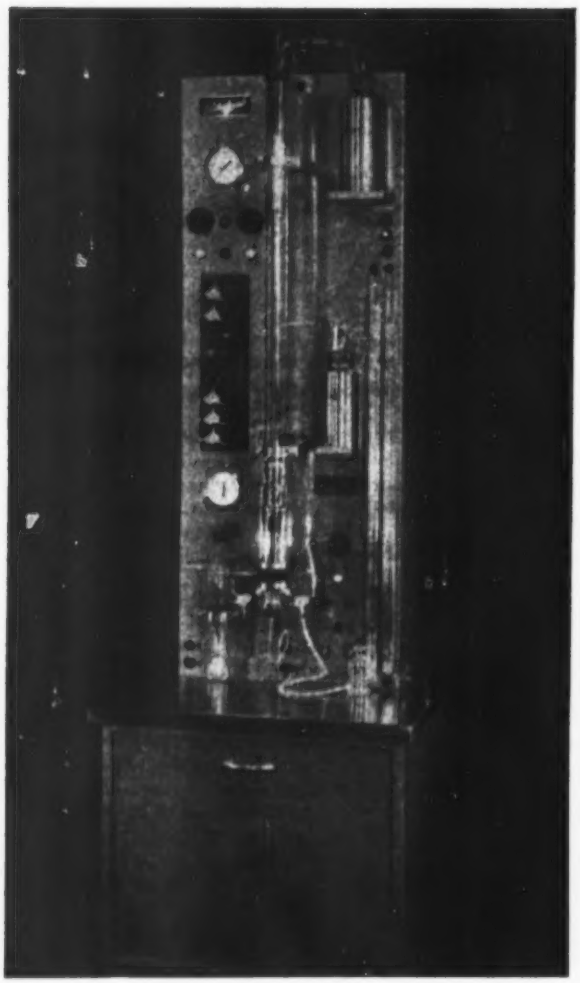

Figure 1. Apparatus is simple and inexpensive.

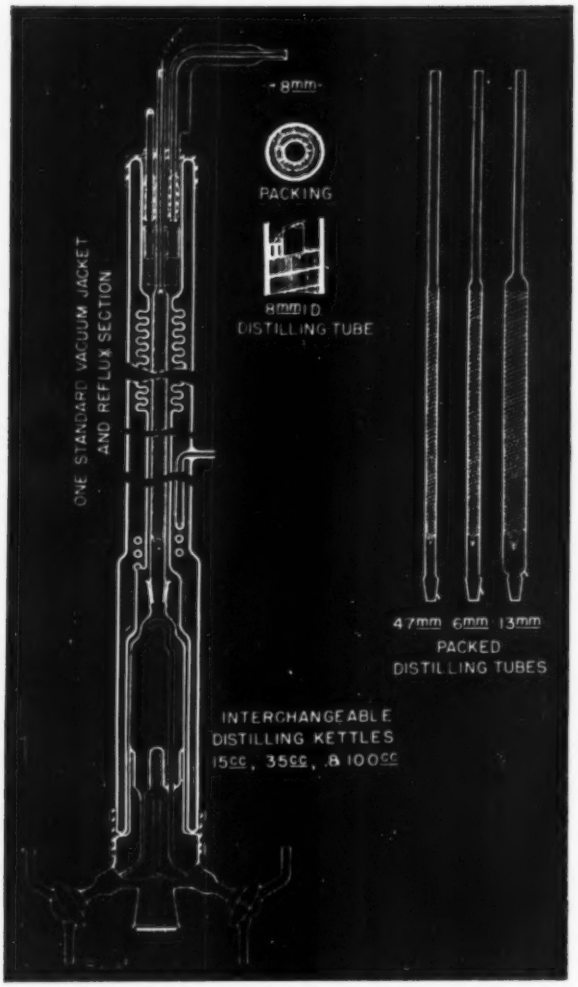

Figure 2. Vacuum jacket and distilling tubes: Identical with automatic apparatus.

Simplified apparatus for . . .

Low Temperature Distillation

This apparatus reverses the trend toward greater automaticity and provides an inexpensive set-up for laboratories requiring infrequent analyses.

S. T. Preston and W. J. Podbielniak,
Podbielniak, Inc.,
Chicago

WHAT IS ONE of the prime needs in laboratory distillation apparatus? A "simpler, less expensive but still effective, automatic or nearly automatic apparatus for general use."[4] The apparatus described here has been designed to meet these requirements. It follows the development of low temperature fractional distillation during the past 25 years. During these years improvement of the apparatus[1] has been directed toward increasing (1) the fractionating efficiency, (2) the ease of operation through addition of automatic controls and (3) the accuracy obtainable through

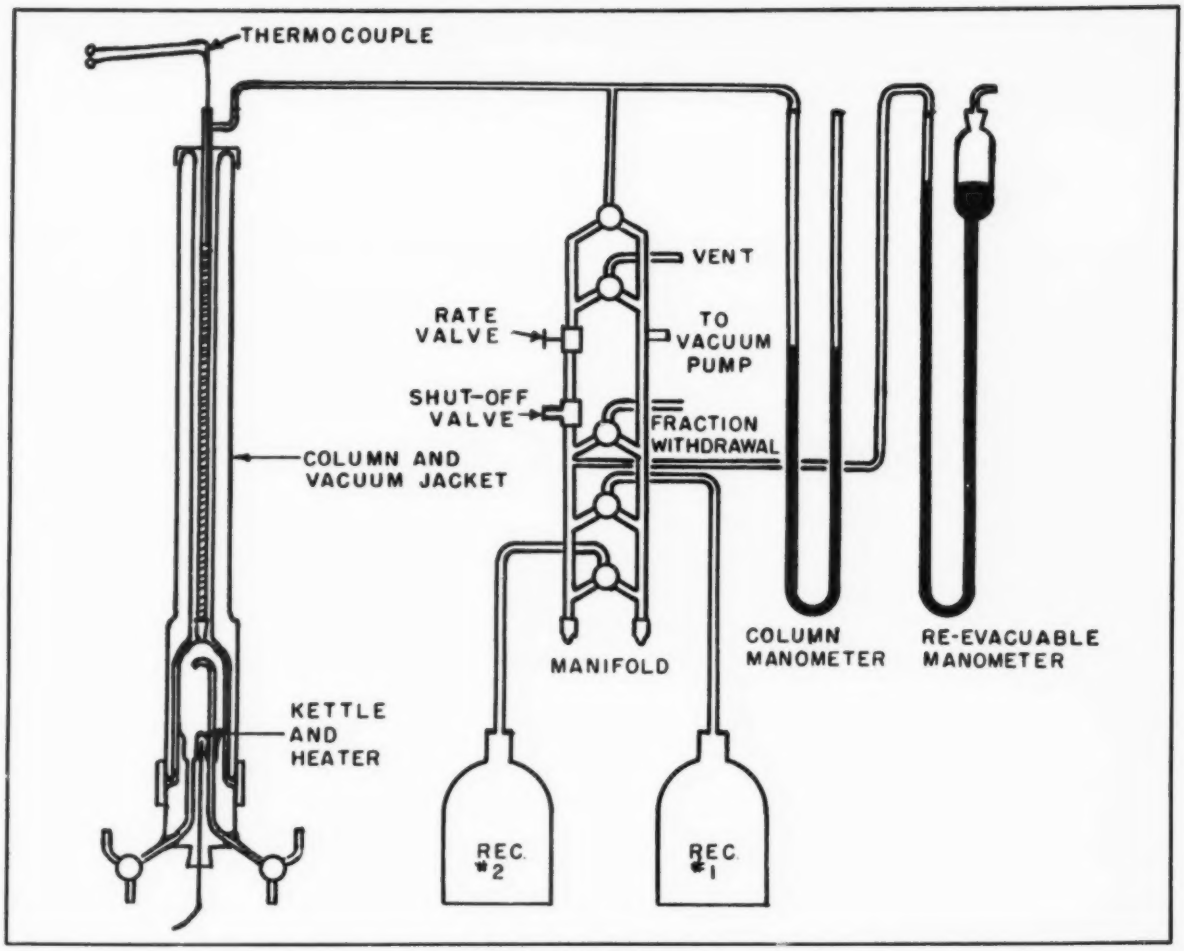

Figure 3. Schematic diagram.

increased precision in measurement and identification of components.

Objectives—There are a number of reasons for the introduction of a simplified partially automatic apparatus at a time when the trend is toward greater automaticity in analytical methods. Laboratories requiring infrequent analyses are unable to justify the expenditure necessary for completely automatic equipment. Universities have many fields of application in both teaching and research for a simple inexpensive distillation apparatus.

Description of Apparatus—The apparatus is represented photographically in Figure 1. A schematic flow diagram is shown in Figure 3. The distilling column and vacuum jacket are identical with those used on the automatic apparatus, and are shown in Figure 2. Packed distilling tubes of 4.7 to 13.0 mm i.d. may be used interchangeably with kettles of 15 to 100 ml capacity. The calibrated receivers are located in a compartment beneath the table which provides partial thermal insulation. Thermostatic control of receiver temperature may be installed by the user to further simplify the operation and the calculation of results.

The stopcock manifold has been designed for maximum simplicity consistent with the flexibility desired. Fractions collected in a receiver may be withdrawn for reanalysis or other tests by the use of a gas collector or freeze-out bulb connected to the fraction withdrawal outlet.

The apparatus is provided with automatic control of distillation pressure; i.e., distillate is removed only while the column is at or above the selected operating pressure, and reflux cooling. The control circuits used to accomplish these functions are shown diagrammatically in Figure 4. The use of thyratrons eliminates arcing at manometer contacts and subsequent contamination of the mercury, and improves the reliability of operation. The distillation shut-off valve is a normally closed, stainless steel, solenoid operated valve. The neoprene seat and packless construction of this valve insure the absence of leaks through the valve and from the surroundings into the vacuum system. Prolonged intermittent operation (about 32,000 cycles) of this newly available valve demonstrated its reliability in providing a vacuum tight seal.

The heat input to the kettle is controlled by means of a variable resistor in a 24-volt supply circuit. A low and high range provide for continuous adjustment of heat input from 0 to 7.5 and 0 to 30 watts respectively.

Operation—The analysis of gases and volatile liquids is accomplished by condensing the sample to be analyzed in the kettle, distilling the components consecutively in order of increasing boiling points, identifying components by measurement of distillate dewpoint temperature, and

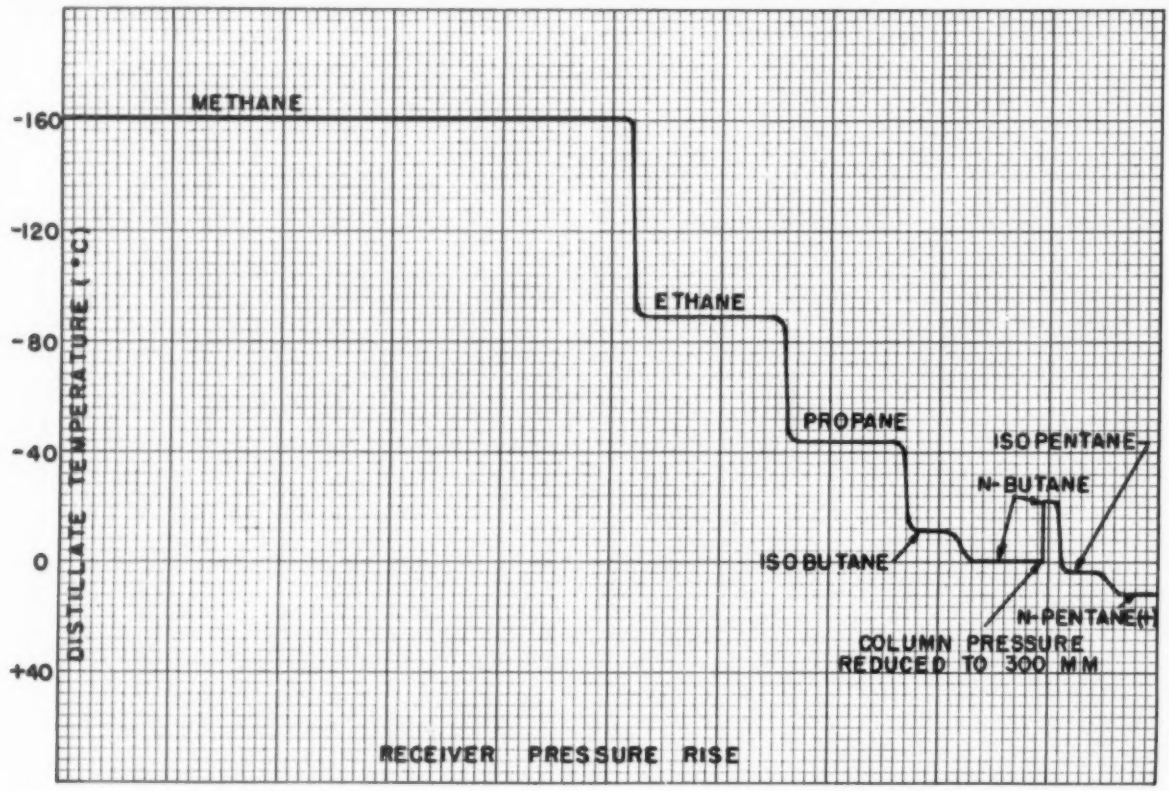

Figure 5. Typical distillation curve.

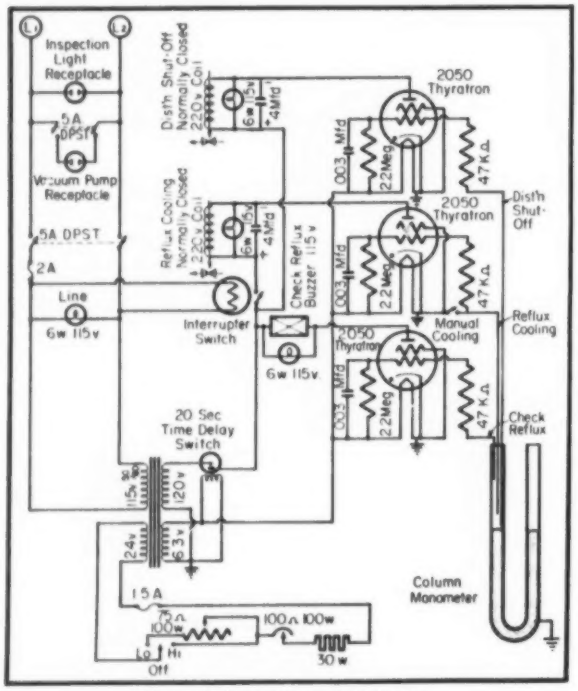

Figure 4. Automatic control circuits.

measuring components in the vapor phase by observing the pressure rise in calibrated receivers. A typical distillation curve as would be plotted from readings of receiver pressure and distillate temperature, is shown in Figure 5. It should be noted that frequent readings of the receiver pressure, during the transition between plateaus, are required to properly delineate the distillation curve. The breakpoint between components is determined from the distillation curve by means of the "equal area" method. The composition of a sample may be computed approximately by dividing the receiver pressure rise caused by each component by the total receiver pressure rise. The accuracy of this calculation procedure is increased by the use of proper corrections for vapor holdup.[2] Precise calculation of results is accomplished by the method presented in a previous paper on LTFD calculation procedures.[3]

Performance—The accuracy obtainable with this apparatus is essentially the same as with the automatic equipment and is limited primarily by the skill of the operator. The frequent readings of receiver pressure and distillate temperature require the constant presence of an operator. The apparatus is characterized by its simplicity and flexibility for general laboratory use.

ACKNOWLEDGMENT

The authors wish to express their appreciation to their associates Carl Marco and Peter Turkal for their contributions in the design of this apparatus.

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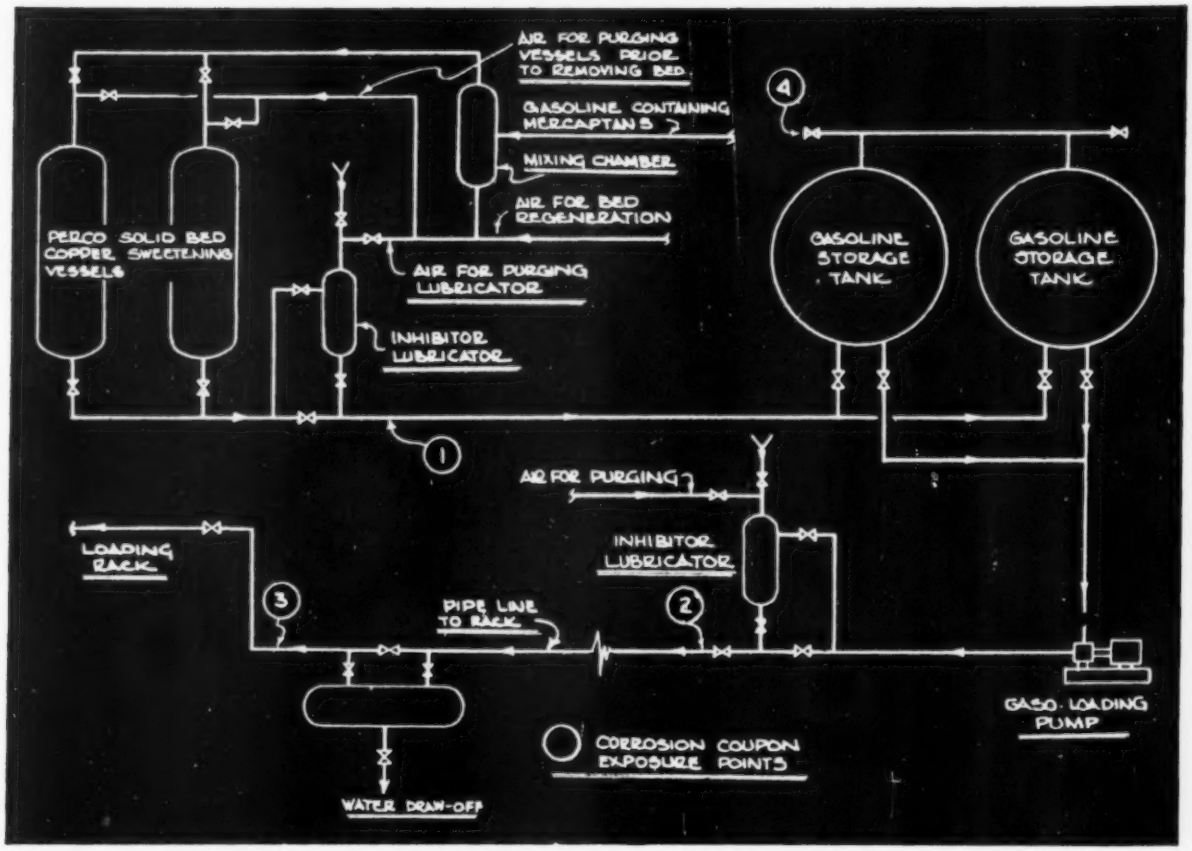


Figure 1. Schematic diagram of sweetening unit shows corrosion control features.

Compare these experiences of . . .

Corrosion in Sweetening Units

In dollars and cents, this report spells out the corrosion associated with two solid-bed treaters.

WHAT RANGE of corrosion can you expect in operating solid-bed, copper sweetening plants? The two units described in this report give two answers. One unit, the older one, has been in service at Plant A for fourteen years. Corrosion experience here has been moderately severe. The other unit at Plant B has operated for almost five years and only moderate corrosion has been experienced.

Corrosive Agents—The corrosive agents result from the sweetening reaction which converts mercaptans to less harmful disulfides as shown in the following equation:

(1) $2CuCl_2 + 2RSH \rightarrow R\text{-}S\text{-}S\text{-}R + 2CuCl + 2HCl$
Cupric Chloride — Mercaptan — Disulfide — Cuprous Chloride — Hydrochloric Acid

The fuller's earth bed, upon which the cupric chloride is adsorbed, is continuously regenerated by oxygen which is blown into the gasoline immediately upstream of the treating bed vessel. The regeneration reaction is shown as follows:

(2) $2CuCl + 2HCl + \frac{1}{2}O_2 \rightarrow 2CuCl_2 + H_2O$
Cuprous Chloride — Hydrochloric Acid — Oxygen — Cupric Chloride — Water

These reactions are, of course, not absolutely complete and undetermined amounts of water, air, cupric chloride,

Natural Gasoline Issue

and oxygen cause corrosion in the Perco bed vessel and downstream in piping and storage tanks. Since the solubility of water and air in gasoline decreases as temperature decreases, it is possible for more severe corrosion to occur at some point downstream after the gasoline cools, thus allowing water and oxygen to come out of solution. Corrosion coupons and loading line failures indicate increased corrosion may occur after the gasoline is cooled during storage.

Plant A Perco Treater

The Perco Treating unit at Plant A consists of three 4 x 10-foot vertical solid bed sweetening vessels. Prior to treatment the gasoline is passed through a caustic wash and a small heater where the gasoline is warmed to about 105 F. This heater was installed in mid 1948 after operating approximately nine years without preheating. It was added in order to increase the life of the treating beds which were becoming saturated with water in about thirty operating days. The vessels are mounted in parallel, but only one is operated at a time. Approximately 900 barrels per day is put through the unit until the effluent tests sour. At that time flow is switched to another unit, and the sour bed is removed for drying and regenerating. A fourth vessel is mounted in parallel with the three previously mentioned, but it is used exclusively for treating butane. Figure 1 is a schematic of the Plant A Perco treater, storage tanks, and loading line which shows the location of corrosion coupon exposure points and the inhibitor lubricators.

Perco Bed Vessels—The first corrosion damage observed was in the water drainline of the Perco bed vessel. Complete penetration of the vessel bottom (0.250 inch head thickness) was known to have occurred within nine years' service (previous penetrations may have occurred) indicating pitting rate of at least 25-30 mils per year.

Maintenance of the 4 x 10-foot Perco bed vessels has consisted of internally sandblasting and repainting the vessels each time the beds were removed for drying and treatment. Deep pits and penetrations have been repaired by welding. During the last three years the beds have averaged one complete cycle every 7.9 months with an operating life of 60-70 days. Repair, surface preparation, and repainting of the vessels each cycle has required an average of 64 man-hours for sandblasting, 20 man-hours for painting and two man-hours for welding. The average maintenance cost has been about $250 per job or $390 per year to keep each vessel in operating condition. Haveg and vinyl paint systems have required replacement each time a bed has been removed. A five-coat vinyl system has recently operated nine months without failure, and was put back in service without repair.

Gasoline Storage Tanks—Inspection in December, 1950, of two horizontal 10 x 40-foot storage tanks (nine storage tanks are installed) after 11 years' service revealed pits as deep as 0.100 inch (corrosion rate—approximately 10 mils per year) in the bottom area where free water could accumulate. Pits of similar depth were observed in the vapor zone, and heavy rusting was present in that portion of a full tank normally covered with gasoline. Since drilled test holes revealed more than specified thickness still remaining (apparently the tanks had been designed for higher pressure service), no further consideration was given to vapor space corrosion. However, since serious vapor space corrosion was recently reported by Plant B, two bull plugs were pulled from the vapor equalizing line of the tanks during June 1953. Uniform pit-type corrosion had occurred throughout the bull plugs at rates of approximately 10 mils per year (mpy). Coupons installed at point 4 in Figure 1 gave corrosion rates of 6.1 and 19.8 mpy. A coupon subsequently installed directly in the tank vapor space gave a corrosion rate of 8 mpy.

In December, 1953, one of the above storage tanks was inspected again. Wall thickness measurements at the four test holes drilled in December, 1950, indicated the following corrosion rates were occurring:

Location of Test Hole	Corrosion Rate in mpy
Bottom of shell	10
Mid-point of shell	10
Top half of head	19
Vapor space	24

In addition, it was significant to observe that corrosion products had accumulated along the tank bottom to a depth of 3-5 inches. The bottom half of the horizontal cylindrical vessel was covered with sheets of corrosion products varying in thickness from ⅛ to ¼-inch. These sheets could be peeled from the vessel wall in sections 2 feet wide by 3-5 feet long and weighed as much as 20-30 pounds. Although pits as deep as 0.100 inch could be measured in the shell beneath this scale, adequate wall thickness still remained. However, the inspection revealed the importance of the problem which was heretofore considered to be of lower magnitude.

In reviewing past observations made in these storage tanks it is significant to note that more corrosion products were observed in the inspected tank in December, 1953, after operating three years since clean out, than were noted in December, 1950, after operating eleven years. No other previous internal observations had been made except in 1946 when another tank was entered to undertake repairs due to mechanical problems. Plant personnel report that no significant corrosion products were observed at that time. Inasmuch as the preheater was operated about eighteen months prior to the first inspection in 1950, and all three years between December, 1950 and December, 1953, it appears that preheater operation was simultaneous to formation of large accumulations of corrosion products in these tanks. Plant tests, using corrosion coupons as guides, are now being conducted to evaluate the effects of preheater operation on corrosion. Additional tests will also be conducted to determine if volatile neutralizing inhibitors, such as those used in controlling steam condensate corrosion, can control this type of attack.

By assuming that most of the damage occurred since installation of the preheater, it can be calculated that the minimum allowable shell thickness would be reached in 6-7 more years at the current corrosion rates. This would result in a total tank life of 11-12 years since corrosion began. Inasmuch as the nine vessels are currently valued at $40,000, the annual cost of corrosion for all tanks then is about $3500.

Plant Piping and Loading Line—After 11 years service a failure occurred in the six-mile loading line about a mile from the plant due to a combination of internal and external corrosion. External corrosion occurred at a point where the protective coating had been damaged by a ditching machine while preparing a ditch for another line. Internal corrosion at this point had reduced the pipe thickness as much as 0.060 inches, and since no corrosion damage had been observed during an inspection at this point 2½ years previously, it appears the corrosion rate at this point in the line was about 24 mils per year. Inasmuch as an increase in temperature of the gasoline to the

treater was effected during this interval, this change may have possibly resulted in putting more corrosive agents into the line as indicated in the storage tanks. Since no corrosive damage was observed at the loading rack at the time of this failure, it appeared that corrosion was either working down the line, or the corrosive agents were becoming spent prior to reaching the rack.

After the first loading line leak, chemical inhibition through lubricators was initiated. However, before arriving at the optimum inhibitor treatment for the loading line, several additional pipeline leaks occurred. These leaks were located in the piping between the Perco bed vessels and the storage tanks, and in the upstream end of the loading line. Consequently, it was necessary to replace approximately 600 feet of pipe, including the effluent manifold of the Perco bed vessels, which cost about $1150. Since this damage occurred over a 14-year period the annual corrosion cost is insignificant. However, it is also necessary to consider the salvage value of the loading line (original cost approximately $40,000) after serving in this mildly corrosive system during the life of the plant. At best the loading line would be worth little more than junk.

On the other hand, the process piping and the loading line have been protected from further damage and maintenance problems have been reduced by inhibition. The corrosion rates at various points in the system before and after inhibition are shown in Table 1.

TABLE 1

	Corrosion Rate in mpy	
	Before Inhibition	After Inhibition
Immediately downstream of Perco bed vessels, Point 1	2.8	0.7-2.1
Downstream from loading pump, Point 2	24.8	2.5-4.2
Loading rack, Point 3	9.2	0.3-0.4

Recent coupon exposures indicate the corrosion rate is still declining and consideration is being given to reducing the treatment. Initially, the inhibitor consisted of a solution of sodium dichromate and sodium hydroxide lubricated into the line downstream of the Perco bed vessels and pumped into the loading line downstream from the loading pump. However, at present no caustic is being used since the pH has remained high, between 9-11, without it. Apparently sufficient caustic is being carried over from the caustic wash to provide adequate pH adjustment. Treatment has been adjusted so that all water drawn off the storage tanks and loading rack drip has a pH of 9-11, and a dichromate concentration of 2000 ppm, although the quantitative test indicates only 200-400 ppm which is thought to be due to interference by other water soluble materials. Present daily treatment is approximately seven pounds of sodium dichromate costing about $1.20. Corrosion coupon exposures of 60-90 days are used for additional corrosion control evaluation.

Plant B Perco Treater

The Perco treating unit at Plant B consists of six 4 x 10-foot vertical solid bed vessels. Prior to Perco treatment the gasoline, or butane in some cases, passes through a caustic wash, a sand filter, and a small heater where the temperature of the gasoline is raised to about 105 F. The treaters are used only when gasoline is being sold to a broker and loaded in tank cars at the plant loading rack; during the remainder of the year untreated gasoline is pumped directly into a crude oil pipe line. The six Perco beds are operated in parallel; each bed being regenerated as required. The maximum rate of throughput per bed in the past has been 750 barrels per day; however, the recent average is nearer 500 barrels per day.

Perco Bed Vessels—Plant records show that pit failures occurred in the bottom heads (5/8-inch thick) of the Perco bed vessels after about nine months operation. These data indicate a pit type attack of 700-800 mpy; however this condition is localized and not representative of average conditions in the vessel.

Since August, 1950, each of the six Perco units has averaged 6.6 months of operation per year. In figuring this average each unit was considered to have operated a month if it was operated for any period thereof. During the 37-month period since August, 1950, these six vessels were sandblasted and repainted 10 times; welding repairs were required five times; and three spot painting jobs were required. The average cost of these jobs has been $200, $50, and $10, respectively. The paint applications have consisted of a three or four coat vinyl system with four coats being used during the last few jobs. Based on these costs and repair frequencies each Perco bed vessel has cost about $125 per year for maintenance required because of corrosion. If the units operated the year round the maintenance cost would be approximately $230 per unit.

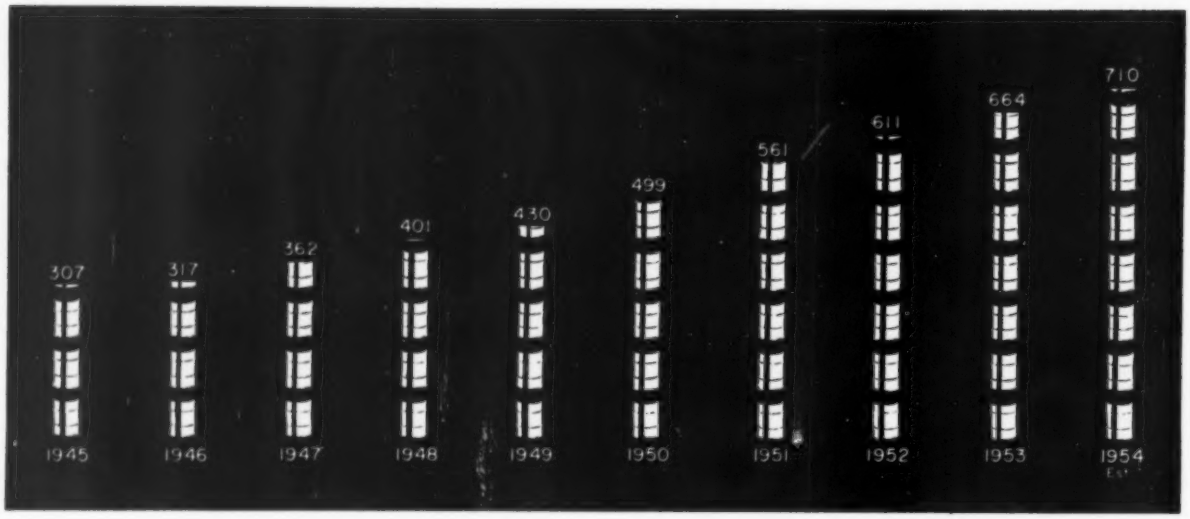
Gasoline Storage Tanks Plant B is equipped with four cylindrical gasoline run tanks and four spheroidal final gasoline storage tanks which have been in service five years. These tanks handle both Perco treated and sour gasoline depending upon the sale conditions described above. Recently one of each type tank was opened for inspection. In each case large pieces of ferric oxide scale were observed throughout the entire inner surface of the tank. In the case of the cylindrical tank the scale accumulations were occupying the major portion of the vessel which would be covered by six inches of liquid. Several test holes were drilled through the vessel wall, and from wall thickness measurements it was calculated that the corrosion rate in the cylindrical tank has averaged about 5-6 mpy and in the spheroid 8.6-10.2 mpy. Corrosion coupons recently exposed in these vessels while handling untreated gasoline gave corrosion rates of less than one mil per year, which indicates the damage occurs during handling of treated gasoline.

Inasmuch as the investment costs for a spheroid is about $20,000 and the cylindrical vessels $6500, and the remaining life at these corrosion rates is estimated at 10 and 25 years respectively, the annual cost of uncontrolled corrosion is then about $1350 for the spheroid and $220 for the cylindrical storage vessels. The present loss of wall thickness has made it necessary to reduce the relief valve setting five pounds so the vessels would not be pressured over API-ASME Code allowable for Unfired Pressure Vessels. Surface coatings are now being tested as a corrosion control measure for these tanks.

Plant Piping and Loading Line During the five years of plant operation, and use of the Perco treaters, no failures have been observed in the plant piping downstream from the treating units or in the gasoline loading line. No corrosion coupon exposures have been made although such tests are planned to further evaluate the environment.

This report, presented to the Corrosion Research Project Committee of NGAA, was compiled through the cooperative efforts of the following Shell personnel: B. W. Bradley, New York; R. W. Schutt and W. V. Alleman, New Orleans; and R. L. Elkins and G. O. Hult, Midland, Texas.

Natural Gasoline Issue



Still climbing: U. S. production of natural gasoline and allied products (quoted in thousand barrels daily)

Natural Gasoline Production Remains High

. . . but the upward trend is due to level off in 1954.

PRODUCTION OF NATURAL GASOLINE and allied products will continue along the upward trend in 1954, but at a rate less pronounced than in recent years.

For these liquid petroleum products extracted from natural gas, market conditions turned unfavorable last year, and they remained that way early this year.

Production exceeded market demand in 1953, and stocks of natural gasoline became burdensome. The inventories at the end of 1953 exceeded 12 million barrels, or more than 50 percent above the 7.8 million barrels at the beginning of the year. The sharp increase in stocks was in line with the accompanying excessive accumulation of total stocks of motor fuel, of which natural gasoline is a part.

Prices of natural gasoline have reacted very definitely to the overproduction and excessive stockpiling of motor fuel, and depressed prices are a cloud over the natural gasoline industry as 1954 begins. The average price of natural gasoline at the plant in the Mid-Continent (Group 3) was only 5.5 cents a gallon in late January, indicating that the average for 1954 may be around that level, if not lower. This would compare with an average of about 5.8 cents for 1953 and 6.2 cents for 1952 and 1951. The 1954 price will be back close to the levels of 5.6 cents a gallon in 1950 and 5.7 cents in 1949, when surpluses hurt the markets.

Price Trend. In 1953, the natural gasoline price started off at a relatively high level of 6.875 cents a gallon, Group 3, but with gasoline stocks rising, dropped sharply in late January and February to 5.5 cents.

The price stayed there until August, when seasonally high demand for motor fuel stimulated sales, and in a few weeks the price rose to 6.375 cents a gallon, where it held until late October. It then dropped abruptly to 5.5 cents a gallon, where it remained in late January, 1954.

LPG Increase. The proportion of natural gasoline going into liquefied petroleum gas products has continued to increase, and the ratio used for blending with other hydrocarbons to make motor fuel has been decreasing. However, use in motor fuel continues to increase in volume as demand for that product rises, and this remains the principal use, representing over 60 percent of the total.

In 1953 sales of LPG for fuel and chemicals represented about 36.6 percent of the demand for natural gasoline, compared with 35.5 percent in 1952 and only 30 percent in 1948. LPG (butane, propane, etc.) is used in cooking, home heating, chemicals, and as a motor fuel for tractors, trucks, busses and drilling rigs.

Sales Breakdown. Of the natural gasoline sold in 1953 about 46.7 percent went to refineries and 15 percent to jobbers for use as motor fuel.

Motor fuel continues to be derived from natural gasoline and crude oil in unchanged proportions. Of all motor fuel produced in both 1952 and 1953 about 11.7 percent came from natural gasoline.

U. S. production of natural gasoline and benzol will average 710,000 barrels daily in 1954, the Bureau of Mines forecasts. That would be 6.7 percent above 1953. The output of 665,000 barrels daily in 1953 was 8.7 percent above the 612,000 of 1952. However, nearly 4½ million barrels or an average of over 12,000 barrels daily went into storage, and actual consumption was up only 6.4 percent, to 652,000 barrels daily from 613,000 in 1952.

Gas Industry Continues Amazing Growth

THE U. S. NATURAL GAS industry continued its amazing growth during 1953. Another big increase is looked for in 1954, the rate of increase in number of gas consuming customers still showing no signs of slowing down.

Annual marketed gas production reached 8.7 trillion cubic feet in 1953, double the volume produced in 1946 and three times greater than in 1941. This was 700 billion cubic feet more than the 8.0 trillion marketed in 1952. Biggest increase came from Texas, which produces half of the gas in the nation. Texas' marketed production in 1953 was 4.6 trillion cubic feet in contrast with 4.1 trillion cubic feet during 1952.

In line with the increase in production, the value of natural gas at wells showed further advancement, reaching an average of 8.3 cents per thousand cubic feet, in contrast with 7.8 cents in 1952 and 5.3 cents in 1946.

Gross production of natural gas is considerably higher, including amounts used in repressuring oil fields and volumes vented or wasted. Data are not yet available on gross production for 1953, but in 1952 the U. S. had a gross production of 10.2 trillion cubic feet. This included 1.4 trillion cubic feet used in repressuring operations, and 858 billion cubic feet vented or wasted.

Natural gas customers have increased more than 150 percent since 1940, while the volume of gas sold by utilities and transmission companies has increased 235 percent during the same period. The number of natural gas customers at the end of 1953 is estimated at 20,611,000, up 6.5 percent from the 19,357,000 at the end of the previous year.

New Reserves Keep Ahead of Production

DESPITE AN AMAZING growth in production during recent years, the U. S. still is finding more natural gas and natural gas liquids than it is producing. Consequently, the nation's proved producible reserves of both natural gas and natural gas liquids continue to rise to new all-time peaks.

Proved reserves of natural gas in the U. S. at the end of 1953 are estimated at 204.9 trillion cubic feet, an increase of over 5 trillion from the 199.7 trillion cubic feet which existed at the end of 1952. This big growth was the result of finding an additional 14½ trillion cubic feet during the year, while production was only 9½ trillion cubic feet.

The nation's proved reserves of natural gas liquids are estimated at 5.4 billion barrels at the close of 1953, a gain of 374.7 million barrels during the year. In contrast with the discovery of an estimated 682.1 million barrels of new natural gas liquids (condensate, natural gasoline and liquefied petroleum gas), production during the year was only 307.4 million barrels.

Big Growth. U. S. reserves of natural gas have risen steadily and sharply in recent years. The 204.8 trillion cubic feet of proved reserves on hand at the end of 1953 contrasted with 180.3 trillion cubic feet at the close of 1949, and 147.7 trillion cubic feet on December 31, 1945.

This represents an amazing increase in view of the huge growth in producing rates during this period. Net production of natural gas has doubled since 1945, when 4.8 trillion cubic feet were produced. By 1949, production had risen to 6.2 trillion cubic feet, and to 9.5 trillion cubic feet in 1953.

From the end of 1945 through the close of 1953, the U. S. produced 50.1 trillion cubic feet of natural gas. During this same period, the country's estimated proved reserves of gas increased by 57.1 trillion cubic feet, indicating the discovery of 113.2 trillion cubic feet of gas.

U. S. proved reserves of 5.4 billion barrels of natural gas liquids at the end of 1953 compared with 3.7 at the close of 1949, and 3.2 at the end of 1946. This increase in reserves has been achieved although production has risen from an annual total of 129.3 million barrels in 1946, to the 1953 peak of 307.4 million barrels.

Large Future Needs. The U. S. will continue to use increasing quantities of natural gas in the future. According to some forecasts, natural gas consumption will be 2½ times larger than 1953 rates by 1975. Consequently, the industry is faced with the need of finding larger amounts of gas in the future.

Heretofore, the industry has depended upon the incidental discovery of gas while seeking oil to make enough supply available to meet requirements. The amounts needed now have become so great, the industry no longer can continue this policy. Instead, it must begin to think in terms of natural gas requirements and inaugurate plans for finding gas as well as oil.

The situation is further emphasized by most of the major gas reserves known today being committed or in the process of being committed to supply specified market. Consequently, the industry will need to consider natural gas discovery and producing requirements, in addition to those of oil, in planning its future exploratory operations.

Texas Leads. Texas has more than half of the nation's recoverable natural gas reserves, holding approximately the same position that it does in crude oil reserves. Latest reserve figures available by states is as of Dec. 31, 1952. At that time Texas was credited with having 105.7 trillion cubic feet of the 199.7 trillion cubic feet in the nation.

Louisiana followed with reserves of 31.4 trillion cubic feet, followed by Kansas and New Mexico with 11 trillion cubic feet each.

Natural Gasoline Issue

Behind the scenes: A wealth of technical personnel

It might be your problem . . .

What Trade Associations Are Doing

NGAA has five technical groups working on knotty problems; seven subcommittees stay on job for California organization.

TO THE OUTSIDER, technical problems worked on by trade associations might seem superfluous in view of the large research and technical staffs maintained by individual companies. But to the industry, both the Natural Gasoline Association of America and the California Natural Gasoline Association have solved some knotty problems that had escaped satisfactory solution by any of the individual companies tackling them alone.

At the outset, the association can assemble more data because of its sheer size and scope. It can also set specification which affect consumer-industry and inter-company relationships. In fact, standardizing product specifications and tests has been their most outstanding contribution over the years.

NGAA Record

For what trade associations are doing, take a look at the NGAA committee work. One of these might be your problem.

Analysis—This group is improving and testing the skill of individual analysts on hydrocarbon analysis. It has already run a highly successful school at Oklahoma University, where 100 laboratory technicians were trained. Now this skill is being tested by exchange of samples. The sixth exchange, begun last month, included 76 plant and research laboratories of 48 oil companies and nine commercial laboratories. The liquid sample sent around is a de-ethanized natural gasoline whose exact composition is

known only by the blender. While most of the analyses will be made by low-temperature distillation, 14 laboratories will also use mass spectrometry, 15 will use infrared, one the Fracton method and one by absorption index.

Absorption—This group has undertaken the monumental task of evaluating absorption tower efficiencies. As a further step, it will set up a standard calculation method for column operation and will compare the applicability of new tray designs. Started four years ago, 22 companies have sent in data. You can expect correlations soon on absorber efficiency.

LP-Gas—This group developed the well-known NGAA technical bulletin on liquefied petroleum gas specifications and test methods. Up for adoption soon: specific gravity test with a new pycnometer, specific gravity test with a new hydrometer, and total sulfur test with a new fast-burning lamp. The commercial propane dryness test (cobalt bromide method) is to be supplemented with a dew point method. Three different dew point instruments are being compared.

Plant Control—Writing a manual on plant control control tests is the function of this group. The manual will contain all the product tests commonly run in the laboratory (as written by the originating technical society or association) and then follow with a step-by-step procedure on the same tests to obtain the desired results. Purpose of the latter part: to give plant operators a more convenient version.

Plant Corrosion—Research by this committee was begun on gas-condensate well corrosion. Off the press this week is the result—a text on "Condensate Well Corrosion." Now the group is turning its efforts toward other phases of plant corrosion. It is a continuous clearing house for 28 companies.

Non-Technical Committees—Other important phases of the industry are studied by the Safety, Traffic, Statistics and Motor Fuel committees. The safety group is currently writing a safety manual for plants. The Motor Fuel committee is an advisory group which arranges automobile road tests. It keeps in touch with engine design, vapor lock tendencies, changes in fuel systems and octane trends. Up for consideration now: the effect of air-conditioning equipment on fuel system design. Under hood temperatures on such cars have risen considerably.

The newest committee is the special LPG Regulations Committee. This group has prepared a code for regulating the construction and operation of underground storage. Objective: to provide regulatory bodies with safe minimum standards on which to base state or federal regulations.

The main Technical committee is currently considering the publication of the best available equilibrium constants. Behind all these committee activities is a wealth of technical personnel as seen in the photo above of the NGAA Technical committee. In the photo (standing, left to right) are: J. H. Check, Continental Oil Company; John F. Webster and Jack Colvin, Fullerton Oil Company; R. G. Boatright and B. J. Heinrich, Phillips Petroleum Company; R. C. Hartman, George H. Holmes, R. E. Styring, Jr., and E. Y. Palmer, The Atlantic Refining Company; H. H. Jones, Sid Richardson Gasoline Company; Frank G. Noble, Humble Oil & Refining Company; C. D. Gard, Union Oil Company of California; W. L. Yauger, United Gas Pipe Line Company; Frank H. Stone, La Gloria Corporation; E. F. Jernigan, Warren Petroleum Corporation; R. C. Frederick, Gulf Oil Corporation; Jim P. Love, Sun Oil Company. Seated (clockwise, left to right) are: E. W. Evans, Phillips Petroleum Company; W. J. Hagner, Jr., J. S. Abercrombie Company; Dwight Seely, Sohio Petroleum Company; A. J. Miller, Phillips Petroleum Company; C. R. Rogers and F. Zapffe, Lone Star Gas Company; Paul W. Tucker, Phillips Petroleum Company; Joe F. Wood, Chairman, Skelly Oil Company; M. F. Wirges, Cities Service Oil Company; Charles Miller, Midland Gasoline Company; Charles E. Webber, Sun Oil Company; S. T. Preston, Podbielniak, Inc.; K. C. Bottenberg, Phillips Petroleum Company; Roy A. Schuster, The Chicago Corporation; J. R. Mason and J. R. Mottley, Tide Water Associated Oil Company; R. R. Hawthorne, The Atlantic Refining Company.

CNGA Keeps Abreast

The California Natural Gasoline Association attacks similar problems to NGAA's but in a different region. Under its Executive committee, seven technical sub-committees study the problems common to the industry.

Sampling—This group has published a bulletin to insure good sampling practices; but with the advent of so many new tests, revision of the basic bulletin is now underway.

Corrosion—The Taft chapter has taken on this problem. First step was to define the problem by gathering data through a questionnaire. Next step will be to find out the costs of gasoline plant corrosion. Also under study: methods of testing for corrosive conditions.

Fundamental Analysis—This group also has a bulletin to its credit—"Tentative Standard Method of Analysis of Natural Gas and Gasoline by Fractional Distillation." Issuance of the new ASTM-IP tables has necessitated revision. This group will correlate the anlysis checking program of NGAA with the laboratories on the West Coast.

Reid Vapor Pressure—This standard method of test is being rewritten to include a method for calculating the Reid vapor pressure from fundamental analysis. Also included: effect of altitude on air saturation.

Charcoal Test—Three different methods of testing for propane content of natural gas are being studied by the use of charcoal. Results of the study will be incorporated in the present procedure, "Charcoal Test for the Determination of the Gasoline Content of Natural Gas."

Physical Constants—Recently published ASTM-IP tables have necessitated the reactivation of a committee to revise the bulletin "Physical Constants of the Components of Natural Gas and Natural Gasoline."

Liquefied Petroleum Gas—This committee is checking the NGAA copper strip corrosion test for liquefied petroleum gas. Present work: to determine the sensitivity of the test to H_2S, free sulfur and mercaptans.

J. H. Watson, Union Oil Company of California, is the present chairman of the Technical committee. Sub-committee chairman (in order of discussion): Guy Cornfield, J. B. Armstrong, I. M. Smith, J. H. Clark, James E. Adams, A. J. Ebersole, and William Spencer.

Natural Gasoline Issue

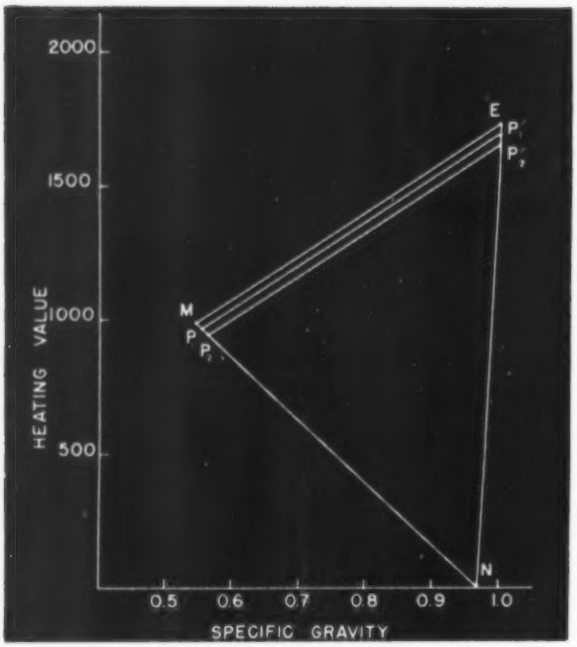


Figure 1. Inert gas correlation development.

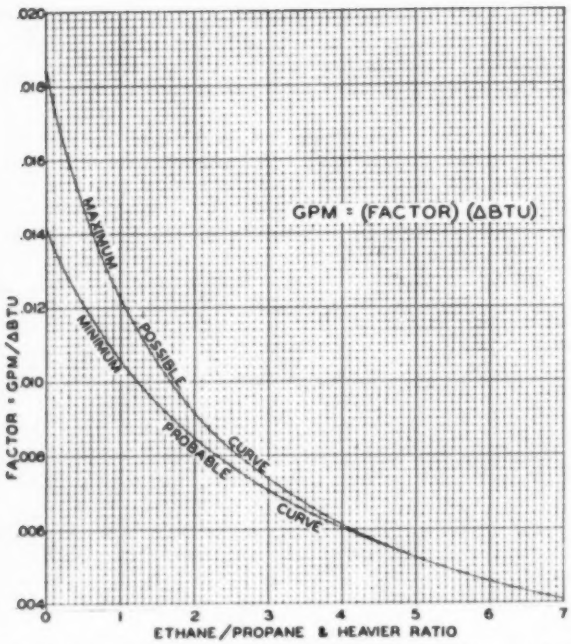


Figure 5. Correlation curves for determining and checking gasoline content.

Natural Gas Correlations

In the laboratory these correlations can be used as a rapid check of the results of a complete gas analysis consisting of heating value, specific gravity, Orsat analysis and fractional analysis.

F. Zapffe,
Lone Star Gas Company,
Dallas

Introduction

THE CLASSICAL method of verifying the accuracy of a complete gas analysis is demonstrated in Table 1, wherein the fractional analysis, corrected for non-combustible gas content as determined by the Orsat analysis, is used as basis for a calculated heating value and specific gravity. Agreement of the calculated values with the experimentally determined heating value and specific gravity indicates that all analyses are probably correct.

Such a method of verification is acceptable in practice until a large number of gas samples need be processed, in which case the time consumed in the arithmetical operations assumes considerable proportions; or until, for any reason, a complete analysis (fractional analysis, Orsat analysis, heating valu and specific gravity) cannot be made. The omission of any one of the four determinations makes the calculated method of verification undependable, if not impossible. Therefore, the Natural Gas Correlations were evolved to minimize the time required to verify the accuracy of the Orsat analysis, when actually determined; and to be able to calculate the quantity of non-combustible or inert gases by means of the laboratory determined heating value and specific gravity, when the Orsat analysis is not made in the laboratory.

An additional development of the correlations permits a dependable verification of the fractional analysis even when the Orsat analysis is not made and further permits a close approximation of the gasoline content of a gas sample with only the heating value and specific gravity

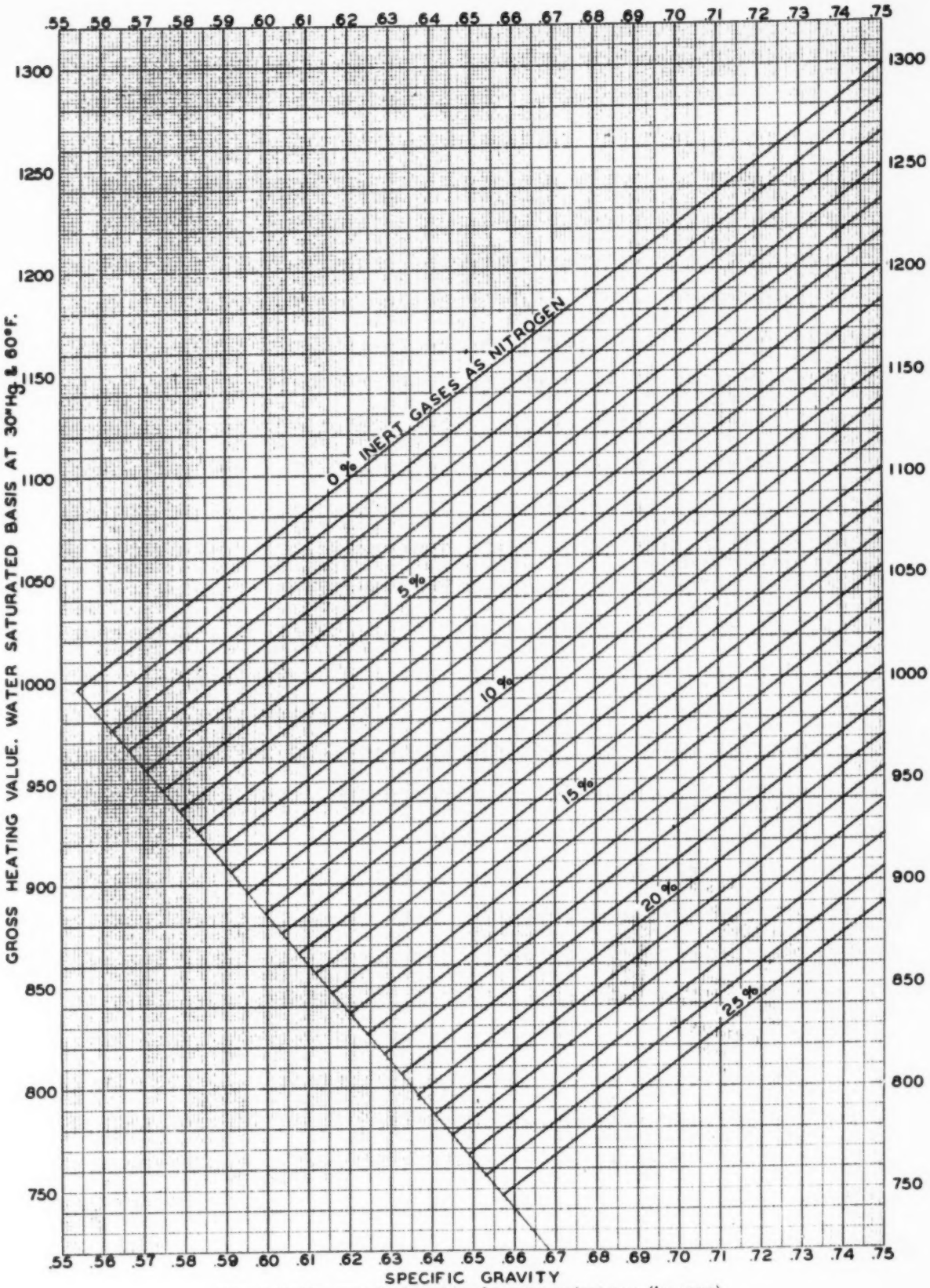


Figure 2. Working curves for determining the percentage inert gases (low range).

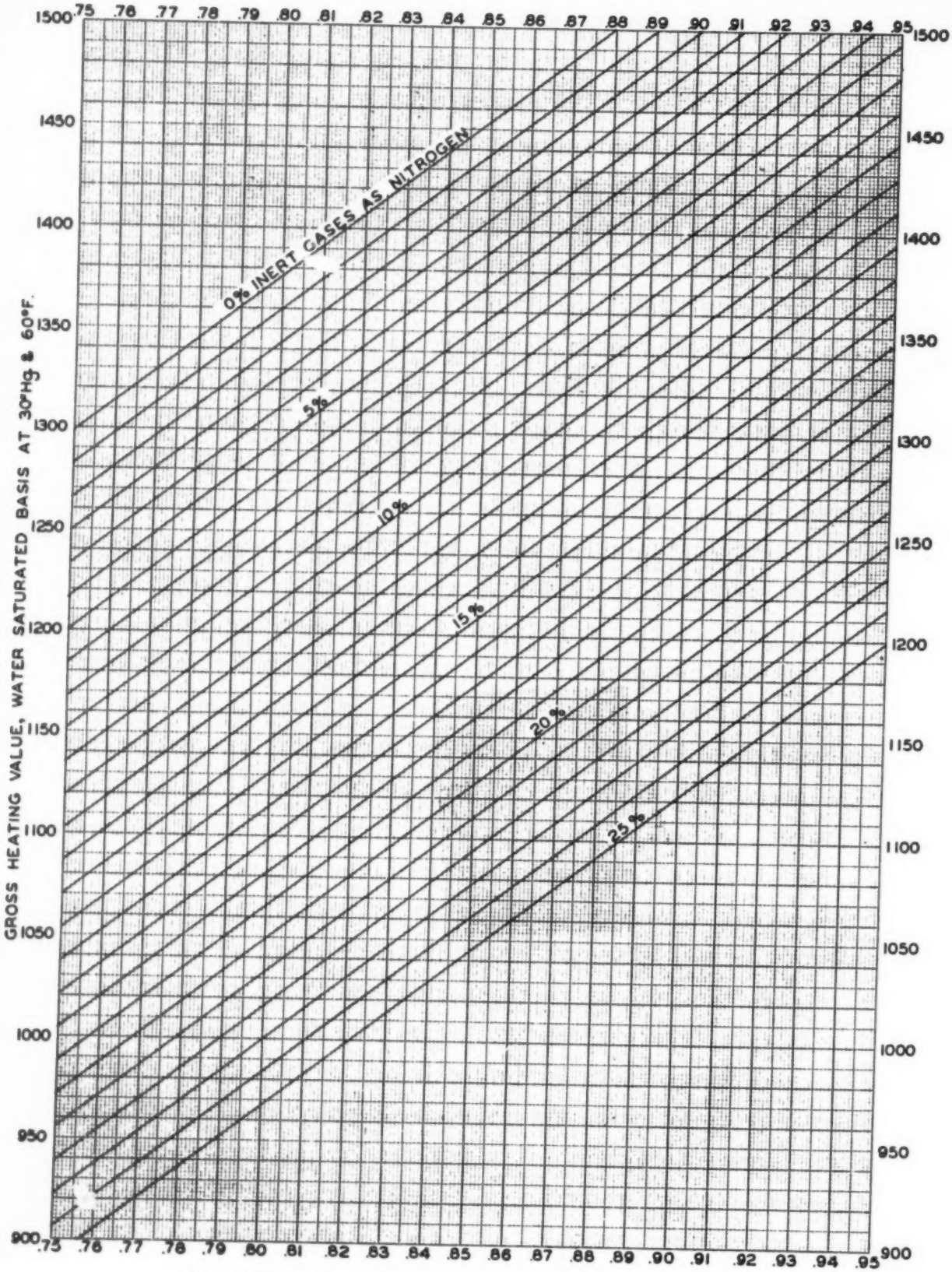


Figure 3. Working curves for determining the percentage inert gases (middle range).

determinations actually being made.

Theoretical Development

The basis for the correlations can best be shown by graphic development.

Using the constants for the specific gravity and the gross heating values, as given in Table 1,[1,2,3] the constants of methane are used to locate point (M) on Figure 1. Using the values of ethane, point (E) can be located in like manner. The heating value of nitrogen being zero, point (N) is located on the specific gravity base line at 0.968. Any gaseous mixture of methane and ethane will fall on Line ME, any mixture of methane and nitrogen will fall on Line MN, and any mixture of ethane and nitrogen will be located on Line EN. Any possible gaseous mixture of methane-ethane-nitrogen must fall within the triangle MEN. Then, if Line MN and Line EN are divided into 100 equal parts and point (P_1) is joined to point (P_1'), Line (P_1P_1') will be the locus of all possible mixtures of methane, ethane and one percent nitrogen. Line (P_2P_2') will represent all mixtures of methane and ethane that contain two percent nitrogen, etc.

From Figure 1 it can be seen that the plot of the heating value and specific gravity of any given paraffin hydrocarbon vapor, mixed with nitrogen, cannot fall to the left of Line ME or Line MN.

The percent nitrogen content can be determined mathematically from a development of the point slope form of the straight line equation for Line ME:

$$Y_e - Y_m = M\,(X_e - X_m) \tag{1}$$

where

Y_e = Heating value of ethane, 1744.7
Y_m = Heating value of methane, 996.0
X_e = Specific gravity of ethane, 1.038
X_m = Specific gravity of methane, 0.554
M = Constant to be determined

$$(1744.7 - 996.0) = M\,(1.038 - 0.554)$$

$$M = \frac{748.7}{.484} = 1546.90$$

Then, for any given mixture of methane and ethane, using methane as the base terminal of the line, the heating value of that mixture can be determined if the specific gravity is known or vice versa. If both values of the same mixture are substituted into the following equation, the equation will equal 100 percent hydrocarbon or zero percent nitrogen:

$$\text{(heating value)} - 996.0 = 1546.90\,[\text{(specific gravity)} - 0.554]$$

or

$$1546.90\ \text{(specific gravity)} + 139.02 - \text{(heating value)} = 0\%\ \text{nitrogen} \tag{2}$$

Solving for the special case of Equation (2) where Line ME becomes point N when the mixture of 100 percent hydrocarbon vapor is displaced by 100 percent nitrogen, the equation becomes

$$1546.90\ (0.968) + 139.02 - (0) = 1636.8 = 100\%\ \text{nitrogen} \tag{3}$$

then Equation (2) divided by $\frac{1636.8}{100}$ or 16.37 will yield, directly, the percent nitrogen of any methane-ethane-nitrogen mixture that falls within triangle MEN:

$$\frac{1546.90\ \text{(specific gravity)} + 139.02 - \text{(heating value)}}{16.37} = \%\ \text{nitrogen} \tag{4}$$

As Figure 1 shows how triangle MEN was developed, so could a similar triangle for any other inflammably inert gas such as carbon dioxide or oxygen be developed. Visualizing such a triangle for carbon dioxide, another special case of Equation (2) can be developed using the specific gravity of carbon dioxide (1.529) and proceeding as in Equation (3):

$$1546.90\ (1.529) + 139.02 + (0) = 2504.2 = 100\%\ \text{carbon dioxide} \tag{5}$$

then Equation (4) as established for carbon dioxide becomes

$$\frac{1546.90\ \text{(specific gravity)} + 139.02 - \text{(heating value)}}{25.04} = \%\ \text{carbon dioxide} \tag{6}$$

and in like manner, the equation for oxygen (specific gravity, 1.106) will be

$$\frac{1546.90\ \text{(specific gravity)} + 139.02 - \text{(heating value)}}{18.50} = \%\ \text{oxygen} \tag{7}$$

As most all natural gas will have nitrogen present in some appreciable quantities, will generally have only negligible to small quantities of carbon dioxide present, will normally contain oxygen only when the gas is processed through a leaking vacuum system, and will usually contain other inert gases in even smaller quantities, the logical procedure is to arrive at the total inert gases in terms of percent nitrogen, then by means of suitable factors, convert the results of the Orsat analysis to nitrogen equivalents for comparison.

The conversion factor for carbon dioxide can be determined by dividing Equation (6) by Equation (4) to give 1.53. Then, the percent carbon dioxide as determined by the Orsat analysis, multiplied by 1.53, will equal the nitrogen equivalent of carbon dioxide:

$$1.53\ (\text{Orsat \% } CO_2) = \%\ \text{nitrogen equivalent of carbon dioxide} \tag{8}$$

In like manner, by use of Equations (7) and (4), the nitrogen equivalent of oxygen is:

$$1.13\ (\text{Orsat \% } O_2) = \%\ \text{nitrogen equivalent of oxygen} \tag{9}$$

Similarly, the nitrogen equivalent of any other inflammably inert gas can be developed.

Thus, all the inert gases as determined by an Orsat analysis can be equated to a value, "Inert Gases as Nitrogen," which can be compared directly with the result of Equation (4).

Practical Application to Natural Gas

The equations as developed are based upon methane and ethane, and for all practical applications are suitable for natural gas composed essentially of the paraffin hydrocarbon homologous series:

Equation (4):

$$\frac{1546.90\ \text{(specific gravity)} + 139.02 - \text{(heating value)}}{16.37} = \%\ \text{inert gases as nitrogen}$$

is best suited to practical use and is the basis for Figures 2, 3 and 4. Theses figures are enlarged sections of Figure 1 with Line EN omitted and with Line ME, Line P_1P_1', etc., extended indefinitely from the minimum value terminus, Line MN.

Equations (8) and (9) are in the most usable form to convert the results of an Orsat analysis to a common term for comparison with the result from Equation (4) or the graphic curves.

To utilize the correlations to best advantage, the laboratory heating value and specific gravity determinations must be to acceptable standards.

The heating value determination, when conducted according to acceptable standards,[4,5] can be successfully reproduced by the same operator within limits of 0.3 percent accuracy; and by a different operator within 0.5

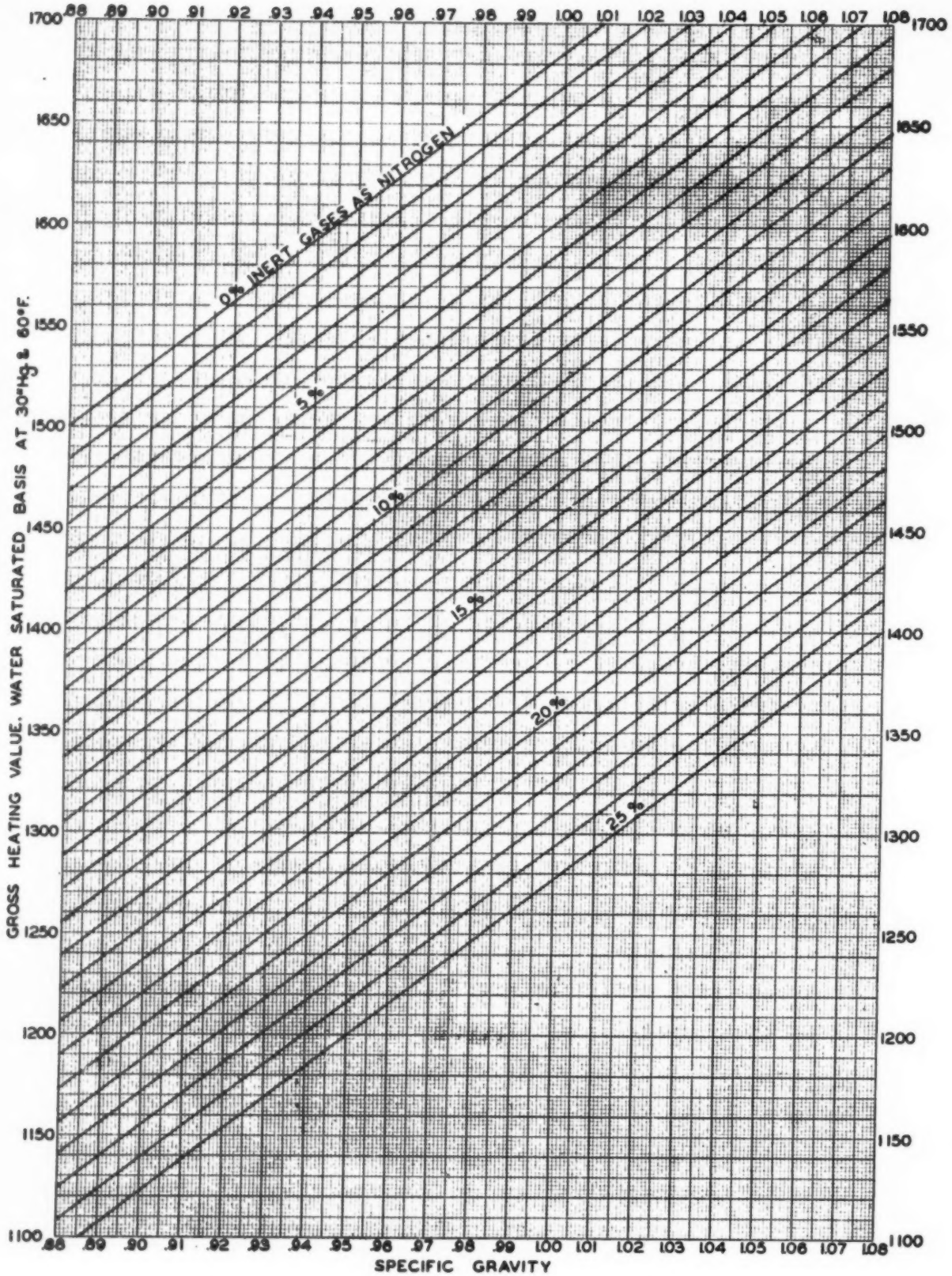


Figure 4. Working curves for determining the percentage inert gases (upper range).

percent accuracy. When the heating value is calculated according to the ASTM D-900-48 standard, it is reported as total or gross heat value per cubic foot, on a water saturated basis, at 30-inches mercury pressure and 60 F. Calculated heating values must necessarily be on the same basis for comparison.

The specific gravity of the gas sample can be determined accurately to at least the third significant figure on any good gravity balance, and by utilizing the excellent suggestions for corrections as outlined in the NBS Publication M177,[3] reproducible results to the fourth significant figure can be obtained under laboratory conditions.

The specific gravity, correct to the third decimal place, together with the heating value, reproducible to 0.3 percent, when applied to the correlation equations or curves will produce more accurate results than can generally be produced by the Orsat determination.

The application of the correlations can best be demonstrated by an example. Assume a sample of natural gas has been received in the laboratory and the specific gravity and heating value have been determined to acceptable standards. Using the laboratory determined values of 0.7662 specific gravity and 1096 Btu from Table 1, Figure 3 can be used for a rapid determination of the Inert Gases as Nitrogen content. The intersection of 0.766 gravity and 1096 Btu can be read at the 13.9 percent Inert Gases as Nitrogen curve. If greater accuracy is desired, Equation (4) can be utilized:

$$\frac{1546.90\,(0.7662) + 139.02 - (1096)}{16.37}$$

= 13.94% inert gases as nitrogen

Should an Orsat analysis not be available, the 13.9 percent or 13.94 percent can be reported as a combined value of all inert gases that will be on a comparable basis for future comparison of the same sample source or for comparison with other gas samples. The usual means of report is under the "Remarks" section of the Laboratory Analysis Record, thus, "Inert Gases, Calculated as Nitrogen: 13.9 percent." This means of report cannot be misconstrued to be an analytical result, nor does it imply that the inert gas is all nitrogen.

Should a laboratory Orsat analysis be available, it can be verified by means of the result of Equation (4). Again Table 1 will be drawn upon. Using only the corrected analysis portion that comes from the Orsat, (The fractional analysis need not be determined to make this portion of the verification.) The mol percent of carbon dioxide, 0.55 percent, is introduced into Equation (8):

1.53 × (0.55) = 0.84% nitrogen equivalent of carbon dioxide

As this is a vacuum sample, the oxygen mol percent is high, 1.10 percent.

Introduced into Equation (9):

1.13 × (1.10) = 1.24% nitrogen equivalent of oxygen

then, the summation of the inert gases from the Orsat analysis in Table 1 will total

CO_2 as N_2	0.84%
O_2 as N_2	1.24%
N_2 as N_2	11.78%
Orsat determination	13.86% inert gases as nitrogen,

compared with 13.91 percent as determined from Equation (4). This verification is sufficient for general application but if closer verification is desired, a correction which will be discussed later can be applied.

Thus, it can be seen that with the Natural Gas Correlations a verification of three analyses without the fractional analysis is possible, and an accurate inert gas figure can be established with only the heating value and specific gravity being determined.

For general applications, the use of the curves in Figures 2, 3 and 4 and slide rule utilization on Equations (8) and (9) will provide sufficient accuracy with minimum time consumption.

A verification of the Orsat anaysis as shown in the example indicates that all three analyses: specific gravity, heating value, and Orsat analysis, are well within limits of laboratory accuracy. Any appreciable lack of verification will indicate that one of the three determinations is in error. As the first two determinations are generally more accurately obtainable in the laboratory, the logical suspect should be the Orsat analysis. While it is difficult at times to decide which determination is actually in error, the correlations have served their purpose in the laboratory if an inaccurate analysis can be prevented from leaving the laboratory. In the absence of a fractional analysis, the detection of an error would be impossible without the natural gas correlations.

TABLE 1
Natural Gas Analysis
Calculated Verification

COMPONENT	Fractional Analysis Mol. Fract.	Corrected Analysis Mol. Fract.	Specific Gravity	Calculated Gravity	Heating[a] Value	Calculated B.t.u.	CF Vapor Per Gal.	Calculated Gallons Per 1000 CF
Carbon Dioxide		0.0055	× 1.529	= 0.0084				
Oxygen		0.0110	× 1.106	= 0.0122				
Nitrogen		0.1178	× 0.968	= 0.1140				
Methane	0.7784[a]	0.6453	× 0.554	= 0.3575	× 996.0	= 642.7		
Ethane	0.1334	0.1327	× 1.038	= 0.1377	× 1744.7	= 231.5		
Propane	0.0835	0.0830	× 1.522	= 0.1263	× 2483.5	= 206.1	÷ 36.45	2.28
i-Butane	0.0021	0.0021	× 2.006	= 0.0042	× 3210.5	= 6.7	÷ 30.65	0.07
n-Butane	0.0018	0.0018	× 2.006	= 0.0036	× 3218.4	= 5.8	÷ 31.79	0.06
i-Pentane	0.0008	0.0008	× 2.491	= 0.0020	× 3943.5	= 3.2	÷ 27.41	0.03
n-Pentane	0.0	0.0	× 2.491	= 0.0	× 3955.3	= 0.0	÷ 27.67	0.0
	1.0000	1.0000		0.7659		1096.0		2.44

Laboratory Determinations:—Specific Gravity: 0.7662; Heating Value: 1096

[a] Methane includes nitrogen and Oxygen, but not carbon dioxide.
[b] Corrected to 60° F., 30" Hg., water saturated basis for direct comparison with laboratory calorimeter results.

Gasoline Content

By the utilization of the concept of "Delta Btu," the accuracy of fractional analyses can be checked within close limits without an Orsat analysis being determined and the gasoline content of gas samples can be estimated within reasonable limits when only the heating value and specific gravity are known.

"Delta Btu" is defined as the difference between the gross heating value of the gas and that hypothetical heating value that would result if all hydrocarbon components except methane were removed from the sample; leaving only methane and the inert gases, calculated as nitrogen. By referring to Figure 1, it will be seen that this hypothetical value of methane and the inert gases will always fall on Line MN, at a point determined by the percent inert gases contained in the sample. This same hypothetical heating value can be determined by the following equation:

$$996.0 - 9.96\,(\%\text{ inert gases as } N_2) = \text{hypothetical Btu of methane and inert gases} \qquad (10)$$

Then:

$$\text{Gross Btu} - [996.0 - 9.96\,(\%\text{ inert gases as } N_2)] = \text{"Delta Btu"} \qquad (11)$$

In using the curves, the heating value as determined by Equation (10) can be picked off Figure 2 at the lower terminus of the proper percent inert curve. "Delta Btu" is necessarily the heating value attributable to the presence of ethane and the heavier components in the gas sample.

Normally, in present practice, the gasoline content is calculated from the fractional analysis by use of vapor-liquid ratios for the various hydrocarbon components as shown in Table 1 or by other comparable methods involving the fractional analysis. The general practice is to report, as gasoline content, any propane and heavier components in terms of gallons of liquid per 1000 standard cubic feet (gpm).

As the value "Delta Btu" is a function of the ethane and heavier components and the gpm gasoline content is a function of the propane and heavier components, then a correlation between "Delta Btu," gpm, and the ethane-propane and heavier ratio can be used to advantage to verify gasoline contents actually determined or to estimate gasoline contents of samples that have not received fractional analyses.

This correlation has been developed in Figure 5. The abscissa is in terms of the ratio of the mol fraction of ethane to the sum of the mol fraction of propane and heavier components (C_2/C_3 + Ratio) and the ordinate is a factor equal to the gpm divided by the "Delta Btu."

To demonstrate the use of Figure 5, Table 1 will again be used as a source of data. To verify the accuracy of the fractional analysis, the "Delta Btu" need be determined. As the "inert gases, calculated as nitrogen" have already been determined to be 13.86 percent from the Orsat analysis, that figure will be used. Then Equation (11):

$$1096 - [996.0 - 9.96\,(13.86)] = 238 \text{ Delta Btu}$$

$$\text{factor} = \frac{\text{GPM}}{\Delta\text{BTU}} = \frac{2.44}{238} = 0.01025$$

$$C_2/C_3 + \text{Ratio} = .1334/.0882 = 1.51$$

A plot on Figure 5 of the indicated ratio and factor will fall between the two curves rather close to the top curve.

As the top curve is theoretically the plot of a gas containing ethane and propane in the various ratios, it is impossible for any plot of a natural gas to fall above this line. The lower curve is a plot of ethane and normal butane mixtures in the various ratios. Experience has shown that very few, if any, gas samples will plot below this curve, which is the minimum probable curve while the top curve is the maximum possible curve. As the sample used as an example is essentially rich in propane insofar as the 2.44 gpm is concerned, the plot should naturally fall near the top curve.

Figure 5 can be used to advantage to determine the gasoline content of gas samples when a fractional analysis is not available. With the heating value and specific gravity determined, either in the laboratory or upon recording instruments, the "Delta Btu" can be determined. Then, to use Figure 5, only the C_2/C_3 + ratio need be known. In the event that nothing is known of the source of the gas, an assumed ratio of 1.5 is an average ratio of many varied types of gas samples, and is also the median ratio of hundreds of samples. In the event that general knowledge is available as to the source of the gas, Table 2 can be used to estimate the C_2/C_3 + ratio to a closer value. By taking a reasonable point between the upper and lower curves at the chosen ratio, a value of the factor can be taken that will yield an approximate gpm content, generally within 10 percent of the true value, when multiplied by the "Delta Btu" as previously determined.

Table 3 contains the necessary data to lay out Figure 5 to any desired scale.

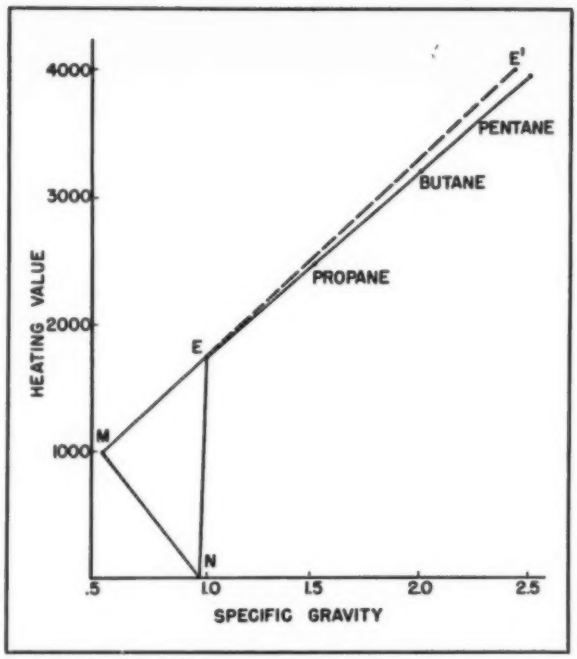


Figure 6. Deviation of correlation calculated results (E') from plot of heavier components.

Deviations

The derivation of Equation (4) is based upon the relation between methane and ethane. Inert gas results determined from a sample containing nothing but methane, ethane and inert gases are theoretically correct. When Line ME in Figure 1 is extended to the right for use of all natural gas samples, a minor deviation from theoretical is encountered. If the plot of propane and the heavier components were to fall on the straight line projection of Line ME, Equation (4) would be theoretically correct for all natural gas samples. As seen in Figure 6, the actual plot of propane, butane and pentane show that as the natural gas hydrocarbon components increase in molecular weight the deviation from the Line ME projection (E') is proportionally greater.

The inert gas determinations as made from Equation (4) are essentially accurate for all practical purposes until samples contain such large volumes of heavier components as to permit the influence shown in Figure 6 to be felt.

Figure 7 is an empirical smoothed curve developed to correct for the deviation due to the heavy end components. After the "Delta Btu," which is the resulting function of the heavier components, has been determined; the value of percent inert gases that need to be deducted from the result of Equation (4) to give the true percent inert gases can be read from Figure 7.

For example, the total inert gases in the example in

TABLE 2

GAS SOURCE—General Classification	Probable C_2/C_3+ Ratio
Vacuum Wells, Atmospheric Oil Stock Tanks, Oil and Distillate Separators (30 psi. or Less)	0.3 to 0.8
Oil and Distillate Separators (20 to 300 psi.), Gasoline Plant Vapors and Reabsorber Feed	0.5 to 1.0
Oil and Distillate Separators (200 to 1000 psi.), Gasoline Plant Residue (Moderate Extraction)	1.0 to 2.0
Average and/or Median Gas Sample	1.5
Dry Gas Wells (High Pressure)	2.0 to 4.0
Gasoline Plant Residue (High Extraction)	2.0 to 7.0+

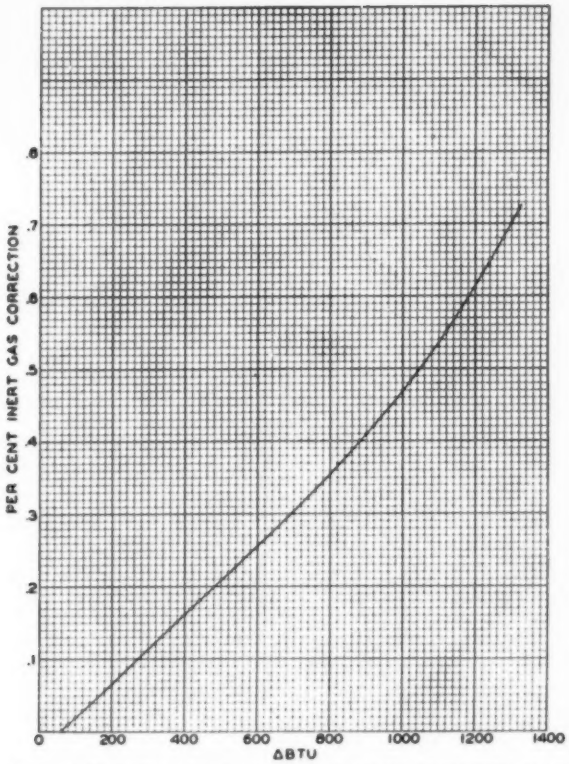


Figure 7. Correction, due to presence of heavier components, to be deducted from calculated inert gases.

Table 1 as determined by Equation (4) give a result of 13.94 percent inert gas; the Orsat analysis tabulation gives 13.86 percent, while the "Delta Btu" is 238. From Figure 7 at 238, the percent inert gas to be deducted from the 13.94 percent is approximately .085 percent. The corrected percent inert gas as thus determined, (13.95 — 0.085 = 13.865 percent) checks the Orsat nitrogen equivalent as previously determined.

The theoretical development brought out the fact that in Figure 1, the plot of any mixture of methane, ethane and nitrogen could not fall to the left of Line ME. This statement remains true when the theoretical development is extended to all natural gas. However, in the case of Line MN, a natural gas plot can possibly fall to the left if the sample contains an inert gas of lower molecular weight than nitrogen. Such an actual plot below Line MN resulted in the indication of the presence of helium in a gas sample. Later, the analysis by the Bureau of Mines at Amarillo confirmed this indication to the extent of 0.7 percent helium.

TABLE 3

Data for Determination of Gasoline Content as Shown in Figure 5

Ethane—Propane and Heavier Ratio	Factor — GPM/Delta B.t.u.	
	Maximum Possible Curve (Propane)	Minimum Probable Curve (n-Butane)
0.0	0.01844	0.01415
0.25	0.01638	0.01305
0.50	0.01474	0.01211
1.00	0.01227	0.01059
1.5	0.01051	0.00940
2.0	0.00919	0.00846
2.5	0.00817	0.00768
3.0	0.00735	0.00704
4.0	0.00612	0.00603
5.0	0.00524	0.00524
6.0	0.00459	.....
7.0	0.00408	.....

Provision for such inflammable but non-paraffinic hydrocarbon components as hydrogen, carbon monoxide and the unsaturated hydrocarbons has not been made in the natural gas correlations due to the very remote possibility that such components are found in natural gas.

No special provision has been made in the correlations for hydrogen sulphide. Concentrations of this inflammable, non-hydrocarbon gas below 1000 ppm or 60 grains per 100 CF have such minute effect upon a verification as to be negligible upon the final result. Concentrations above this value, as determined by the Tutwiler burette or comparable method, should be set up in the more conventional form of verification as shown in Table 1.

Summary

The natural gas correlations as developed can be used to advantage in several ways:

(1) In the laboratory, when a complete gas analysis consisting of the determination of the heating value, specific gravity, Orsat analysis and fractional analysis is made, the correlations can be used to advantage to rapidly check the results. Due to the several methods in the correlations of checking and plotting against known standards, it is possible in many cases to quickly establish which determination is in error. Systematic evaluation of errors in successive analyses can lead to the improvement in laboratory technique and thus improve future determinations.

(2) In the laboratory, when an Orsat or fractional analysis cannot be made due to lack of sample or time, the correlations can supply such needed information from the determination of the heating value and specific gravity, each of which can be made within an hour, compared to the much longer time required for the fractional analysis. When the Orsat analysis is omitted, the correlations permit an accurate verification of the other determinations that cannot be achieved by conventional methods. In fact, by means of the correlations, any three, or sometimes two, determinations can be used to arrive at either exact information or close estimates of the values of the missing determinations.

(3) In small laboratories that do not have fractional analysis equipment, the comparatively inexpensive calorimeter and gravity balance can provide information relative to the gasoline content and perhaps minimize the number of samples that might need to be contracted out for fractional analysis.

(4) At such points as purchase stations for gas transmission lines, the recording calorimeter and gravitometer readings can be used to check contractual obligations both as to inert gases and gasoline content. Power plants can use the same method to determine effect of inert gases upon combustion efficiencies. In both cases, not only the basic contents can be determined, but the instantaneous changes can be determined.

(5) The basic correlations can be used, or modified for such use, as mixture control charts for operation and control of LPG-Air mixing plants.

REFERENCES

[1] Natural Gasoline Association of America Standard 2145 - 1945.

[2] California Natural Gasoline Association Technical Standard 401 — Second Edition.

[3] International Critical Tables.

[4] ASTM Procedure D-900-48 for Water-Flow Calorimeters.

[5] National Bureau of Standards Circular No. 48 - "Standard Methods of Gas Testing."

[6] National Bureau of Standards Miscellaneous Publication M-177 - "Test of Instruments for the Determination of Specific Gravities of Gases," U. S. Government Printing Office $1.

Natural Gasoline Issue

1 From base stations . . .

2 To antenna mounted on pipe still . . .

In MAINTENANCE . . .

Radio Solves Many Problems

Dependable radio communications will save time, money and personnel whether it's a normal operation or an emergency.

C. L. Rose,
Standard Oil Company (Indiana),
Casper, Wyo.

THE EFFICIENCY of the maintenance division of a refinery is dependent upon its lines of communication. The mere fact that the organization may be composed of skilled mechanics equipped with the best tools and staffed by well-trained and loyal supervisors does not guarantee the most economical or efficient service. If there are men or machines idle when there is work to do, if there are delays in getting instructions to men or supervisors, then the maximum capacity of the division is being lost simply because of inadequate means of contact. A number of the operations can be controlled by careful planning and regular scheduling, but unfortunately considerable maintenance work is too irregular to conform to this procedure. Therefore, there must be some simple medium by which supervisors and mobile equipment can be contacted.

MAINTENANCE / OPERATION

In small areas this can be accomplished by audible or visual signals but the physical size of Standard Oil Company's (Indiana) Casper refinery make these methods impractical. Originally, it was two separate refineries—each with its own utilities; processing units and attendant pipe lines. Consolidated the plant is 2¼ miles in length, covers 320 acres, is divided by the busy Yellowstone Highway and has its processing units widely distributed over the entire area. Up until about two years ago, communications system consisted of an interplant PBX dial telephone system, augmented by telephones at important

3 To a Mobile Unit.

units furnished by the Mountain States Telephone and Telegraph.

In addition to this there was used a paging system consisting of two small steam whistles actuated by a coding device operated by a watchman. This was used to call key supervisors, but with only moderate results. The best service we could expect this method to accomplish was to establish contact in ten minutes and the average call took considerably more time and the percentage of incompleted calls ran quite high. Not only was this method inefficient but the constant blowing of these whistles was not conducive to the best community relations.

The Perfect System—Recognizing our need for improvement we determined what would be the best answer to our problem. *The perfect system would be one which would:*

(a) *Reach the supervisor or service truck instantly no matter where they were located.*

(b) *Permit two-way exchange of information.*

(c) *Where more than one craft was involved to permit a semi-conference of all supervisors.*

(d) *Enable detailed orders to be given.*

(e) *Not disturb other workers or the community.*

The nearest approach to the solution of this problem was the two-way mobile radio. It was decided that the initial system would consist of a base station with two remote controls, one to be located in the Machine department office and one in the Labor and Transportation office. Service trucks of the Pipe, Boiler, and Carpenter departments and two flat beds with tail lifts were equipped with mobiles. Pickup trucks driven by two supervisors in the Machine, two in the Labor, and one each of the Pipe and Insulating departments were likewise equipped. To this original equipment have been added one mobile for Pipe Shop supervision, one for Welding, one for Labor, one for combined Labor and Lube shift foremen and one for the Light Oils shift foremen. There also was installed one additional remote control for our base station in the watchman's house at the main gate.

The base station was located at our vacuum pipe still and was connected to the emergency lighting system of that unit in order that we might be assured of power at all times. An 18-foot antenna was installed at the top of the distillation tower 65 feet above ground level and there is a calculated range of 35 to 40 miles to mobile units. The mobile units were installed in the glove compartments or in the center section of the instrument panels of the trucks and they have a calculated range of from 5 to 10 miles mobile to mobile. Also installed were alternators in all radio equipped trucks to assure that the batteries will be constantly charged and that there will be ample power for transmission.

The operator of the remote control at the Machine Shop acts as monitor for the system on day shifts and also is the dispatcher for the service trucks of the Machine, Boiler, and Welding departments and transmits calls to supervisors of these departments. The clerk at the Labor department office acts as dispatcher for the transportation trucks and transmits calls for Labor, Transportation, and Pipe departments. The watchmen at the main gate act as monitors for the night shifts, serve as base contacts for the shift foremen and transmit calls and messages to all mobile units.

Two Types of Functions—Notice there are two types of "functions" equipped with mobile units—service trucks and supervision. There is a distinct difference in the use to which the radio is applied and likewise in what the application has accomplished.

The service trucks are used to deliver material and supplies. Generally, these are in small quantities and traveling time from one point to another is relatively short. With radio control, the dispatchers and supervisors are in constant touch with these trucks. This gives much closer supervision and increases the effectiveness of the trucks, especially in emergencies. Without radio the service truck drivers reported to the dispatcher, at the completion of each job, either by phone or in person. Now the orders are given while the truck is in motion, thus eliminating all lost time of reporting. It is also possible to change instructions and reroute the truck if jobs of greater priority develop. It eliminates or reduces to a minimum, nonproductive travel time.

One of the largest savings is in reduction of time delays of mechanics waiting for needed material or tools. This is especially true where the repair work reveals that additional material is needed or that some special tool is required. Theoretically, this closer contact and control should re-

duce the number of trucks. Actually, in our case it has not because the time saved has been utilized to give better service to the mechanics. One such service is to contact workmen in isolated areas more frequently, to receive and transmit reports on job progress, and to ascertain material needs.

Briefly, it is felt the radio equipped trucks:

- Reduce waiting time of mechanics.
- Are more effective because of closer supervision.
- Are more efficient because they can be dispatched quickly—can be controlled instantly in cases of emergency.
- Save drivers time spent in nonproductive reporting or traveling for productive work.
- Serve as a roving network of eyes and ears to report fires, accidents or other emergencies.

Reduces Labor and Worries—Radios in the foremen's trucks are for the purpose of receiving or transmitting orders and information from or to other supervisors. They are also for the purpose of receiving information or transmitting information and orders to their crafts. These mobile units extend the field of supervision while reducing the supervisor's labors and worries. With them they are in regular touch with their control station. Whenever they leave their trucks they report their location and when they return they notify their control of the fact they can receive messages. If during the time they were off the air, routine information was received it is now given them.

However, if an emergency had developed, the control station knowing their location could have reached them by either the plant telephone or by contacting a truck or other supervisor in the area by radio. The occasion would be rare where a foreman assigned to a radio truck could not be contacted in a comparatively brief time. This ease with which a foreman may be contacted is in reverse much more convenient. His shop is at his finger tip. He needs only to depress the button on the microphone. Instantly he can order material or manpower, relay information to his superiors of job conditions or job progress, and best of all it can be done even as he moves to the next job or location. In a plant of magnificent distances where perhaps a pipe gang is ¼ mile to the nearest phone, the time saved is considerable when the supervisor on the spot radiophones the pipe cuts to the control station.

"Under regular conditions short-wave radio functions smoothly and easily, but under abnormal or emergency conditions it can and should achieve spectacular results."

Their greatest assistance is when unanticipated or emergency jobs arise—jobs that require the services of more than one craft and which demand coordination between the crafts. Without the mobile units the best method was to call a meeting of the supervisors involved to discuss the problem. Valuable time was lost contacting the foremen and arranging the meeting, more time was lost assembling for the meeting, and still more was wasted mobilizing the men and material.

Contrast this with supervisors provided with radio. Assuming an imaginary yet typical event—A machinist on a routine service to a blower at the acid plant discovers a crack in the housing of the blower. He calls his shop by telephone, the shop contacts his foreman by radio. After inspection and a short conference between the machinist, foreman and operating supervisor, it is decided that the blower must be replaced with the spare which is stored in the warehouse. The crafts involved in the change besides Machinists are electrician to disconnect the motor, carpenters to build a scaffold, insulators to remove pipe covering, pipefitters to disconnect piping, heavy gang with transportation to remove the old blower and install the new one, after which the same crafts must reverse the process.

The heavy gang being the craft which will need the most time and manpower is contacted by radio and the job is explained and a tentative time schedule is established contingent upon the ability of the other crafts to meet it. The supervisors of the Pipe, Carpenter, and Insulation departments have been listening to the two-way conversation and are now drawn into the conference and final agreements are reached as to the timing of the project. Within a matter of minutes a conference has been held, plans made, and the job is in progress, with at least one-half the conferences never interrupting their work.

Briefly, the foremen used the radios to:

- Transmit information back to the shop and their superiors.
- Receive orders and information.
- Summon help from their own or allied crafts.
- Coordinate jobs in progress.
- Order material.

Advantages Are Many—The advantages derived by the foremen being so equipped are:

- Foremen can be contacted in a very brief time.
- There can be a two-way exchange of information.
- No time is wasted going to a phone or reporting in person at the shop.
- Time is saved when breakdowns occur because help can be dispatched immediately.
- Efficiency is stepped up because men and equipment can be assembled quickly wherever a special situation occurs.
- Foremen have more time for direct supervision.

These are the advantages of short-wave radio in the performance of normal maintenance. Under regular conditions it functions smoothly and easily—so smoothly that in a short time its effect is scarcely noted—but under abnormal or emergency conditions it can and should achieve spectacular results. During a fire, even though the normal lines of communication are open, one set located in the fire area and the balance at strategic points can keep help and material flowing into the distress area without interruption. Under conditions like these the unit at the fire assumes control over the network and has instantaneous contact with all strategic points. The advantage of such a system when the normal channels of control are down is exceedingly more important. Then it is the only means by which additional water pressure, tools, men or materials can be summoned quickly. No other communications system can match two-way radio for dependability under adverse conditions. Sleet, tornado, fire, or other destructive forces may sever the telephone line, but so long as truck motors can be started, short wave radio communication can be maintained.

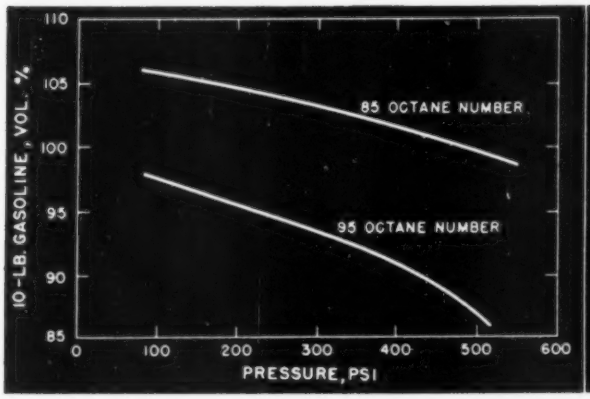


Figure 1. Effect of pressure on gasoline yield (Mid-Continent naphtha).

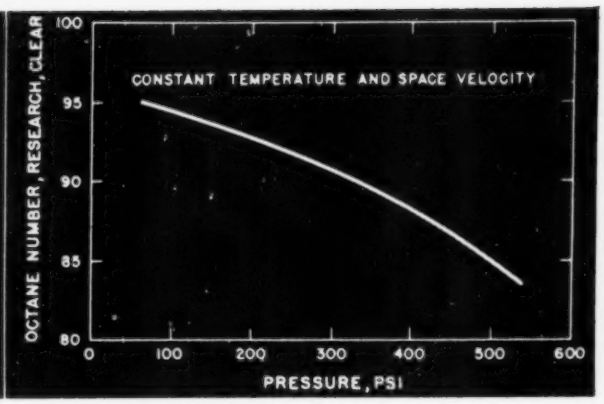


Figure 2. Effect of pressure on octane level (Mid-Continent naphtha).

Ultraforming—New Reforming Process

This catalytic process takes advantage of the high yields and octane numbers offered by operation at low pressures.

Platinum-on-alumina catalyst is maintained at high activity by a novel regeneration technique that goes beyond mere carbon removal.

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Standard Oil Company (Indiana)
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THE PRESSURES at which reforming is carried out affects gasoline yield, attainable octane level, hydrogen production, and rate of catalyst deactivation. In this discussion, gasoline yields will be expressed as volume percent of C_5+ reformate plus enough butane to bring the Reid vapor pressure to 10 pounds. Octane numbers will be reported by the Research method and without tetraethyllead.

Lower pressure gives higher gasoline yield, particularly at high octane levels. This effect is illustrated in Figure 1. At the 85-octane level, gasoline yield increases about 3.5 percent when pressure is reduced from 500 to 300 psi. Further reduction to 200 psi increases yield another 1.5 percent. At the 95-octane level, the effect of pressure is even greater: the corresponding increases are 7 and 2 percent. The improved yield results from less hydrocracking at lower pressure. Not only is the yield of C_5+ reformate higher, but its vapor pressure is lower and more butanes can be added to give 10-pound gasoline. The advantage of low-pressure operation may perhaps be more readily visualized by considering a plant operation at constant pressure in which it becomes necessary to increase octane number from 85 to 95. At 500 psi, the octane number increase would result in a yield loss of 13 percent; at 200 psi, the yield loss would be only 9 percent.

Lower pressure also makes it practical to attain higher octane levels with a given naphtha. This advantage is evident from Figure 2, in which octane level is shown as a function of pressure with other process conditions held constant. Octane level can be increased from 85 to 93, for example, by decreasing pressure from 500 to 200 psi. Lower pressures permit high octane numbers without resorting to unduly severe reforming and incurring prohibitive losses in gasoline yield.

Low-pressure operation results in better yields of hydrogen, a valuable by-product of catalytic reforming. In Figure 3, hydrogen production in standard cubic feet per barrel is shown as a function of pressure for a Mid-Continent naphtha. At the 95-octane level, hydrogen production increases by 210 standard cubic feet per barrel upon reducing pressure from 500 to 300 psi. An additional increase of 110 standard cubic feet per barrel results from further reduction of pressure to 200 psi. The increased hydrogen yields are due both to increased production from dehydrogenation reactions and reduced consumption by hydrocracking.

As the pressure is lowered, platinum catalysts accumulate coke faster and hence deactivate faster. A more-rapid decline in octane number results. In Figure 4 the decline is shown for operations at 200, 300, and 500 psi in which temperature is adjusted to give the same initial octane number. At high pressure, the decline rate is low enough to permit continuous reforming. At low pressure, octane declines more rapidly and continuous reforming is no longer possible.

Yield decline also is more rapid at lower pressure. In Figure 5, the decline in gasoline yield is illustrated at pressures of 200, 300, and 500 psi for operations in which temperature is gradually increased to maintain constant octane number. To compensate for the more-rapid octane and yield

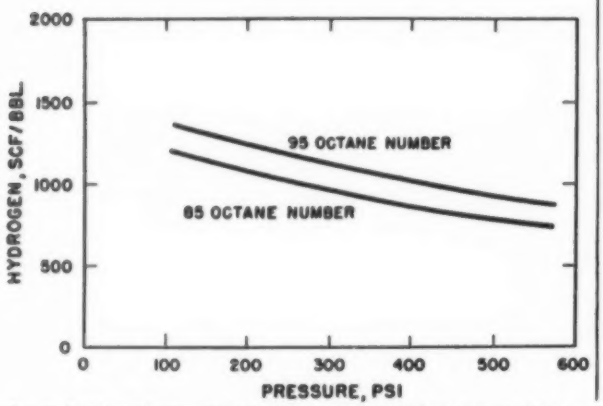

Figure 3. Effect of pressure on hydrogen yield (Mid-Continent naphtha).

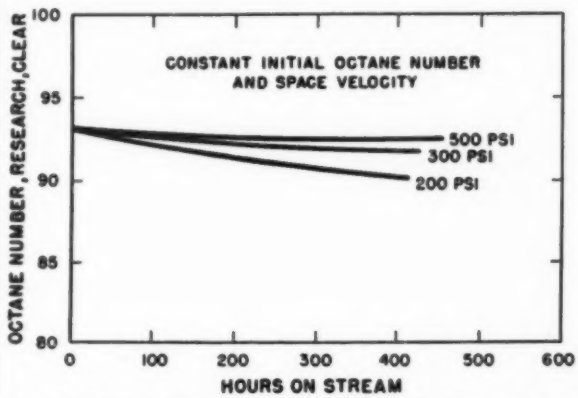

Figure 4. Effect of pressure on octane decline (Mid-Continent naphtha).

decline, regeneration is required. The problem of successfully regenerating platinum catalysts has been the principal deterrent to the commercialization of low-pressure reforming.

This problem has been solved by a new catalyst and a novel regeneration technique in the Ultraforming process. Ultraforming catalyst contains 0.6 percent platinum on an alumina support. The regeneration goes beyond mere removal of coke; it completely restores the catalyst to fresh condition.

The Ultraforming Process—A flow diagram of the Ultraforming process is shown in Figure 6. Naphtha feed and a hydrogen-rich gas are passed through a furnace and heated to 900-950 F. The naphtha and gas are then passed over platinum catalyst in a series of reactors where the naphtha is upgraded to high-octane reformate. The predominant reactions are endothermic and cause a large drop in temperature across each reactor. Reheat furnaces are therefore provided between reactors. Effluent from the final reactor is condensed and separated into a liquid stream and a hydrogen-rich gas. The liquid is stabilized and withdrawn as finished reformate. Most of the gas is recycled with fresh naphtha charge; the off-gas can be used as a source of hydrogen or as fuel.

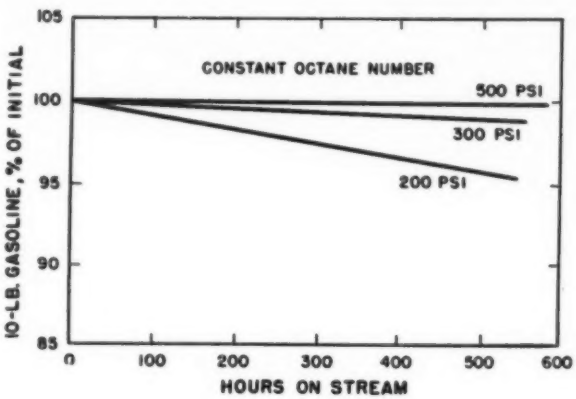

Figure 5. Effect of pressure on yield decline (Mid-Continent naphtha).

To allow continuous naphtha processing, use is made of a swing reactor. As the catalyst in any reactor loses activity, that reactor is isolated from the naphtha-processing system and regenerated, employing air and inert gas. Its place is temporarily taken by the swing reactor, which contains regenerated catalyst. In Figure 6, the swing reactor is being regenerated and naphtha is being processed in the other three. The frequency of regeneration depends on the reforming severity and the type of feed.

The ability to restore Ultraforming catalyst completely to fresh quality gives the process flexibility. A broad range of operating conditions can be used; naphtha varying widely in character can be reformed successfully. Thorough regeneration also provides insurance against permanent catalyst damage from operational upsets. During pilot-plant operations, Ultraforming catalysts have been subjected to reforming temperatures as high as 1130 F., to pressures as low as atmospheric, to periods without hydrogen recycle, and to feeds boiling as high as 540 F. Although deactivation was severe in each case, activity was completely restored by the regeneration technique.

TABLE 1
Ultraforming of Different Naphthas

FEED	GULF COAST		MID-CONTINENT				ARKANSAS	
ASTM Distillation, °F.								
Initial	202		206				149	
10 Percent	250		237				172	
50 Percent	305		274				244	
90 Percent	356		324				322	
End Point	394		361				377	
Composition, Volume Percent								
Paraffins	26.0		50.0				77.0	
Naphthenes	55.5		41.5				15.0	
Aromatics	18.5		8.5				8.0	
Octane No., Research, Clear	59.4		44.5				45.3	
PRODUCTS								
Pressure, Psig.	300		200		300		300	
C5+ Reformate								
Octane No., Research, Clear	90	100	85	95	85	95	85	90
Yield, Volume Percent	91.8	83.8	90.5	84.1	89.9	82.8	84.5	80.0
RVP, Psig.	2.0	3.3	2.1	2.6	2.4	2.8	5.4	6.0
Butanes, Volume Percent	2.7	6.2	2.0	4.4	3.1	5.5	7.1	9.3
Dry Gas, Weight Percent	3.4	7.2	3.3	6.7	4.8	8.4	7.5	9.8
Hydrogen, SCF/B	900	1100	1080	1200	970	1150	540	590
10-Lb. Gasoline								
Octane No., Research, Clear	90	100	85	95	85	95	85	90
Yield, Volume Percent	105.7	93.2	104.5	95.2	103.1	93.3	91.8	85.7

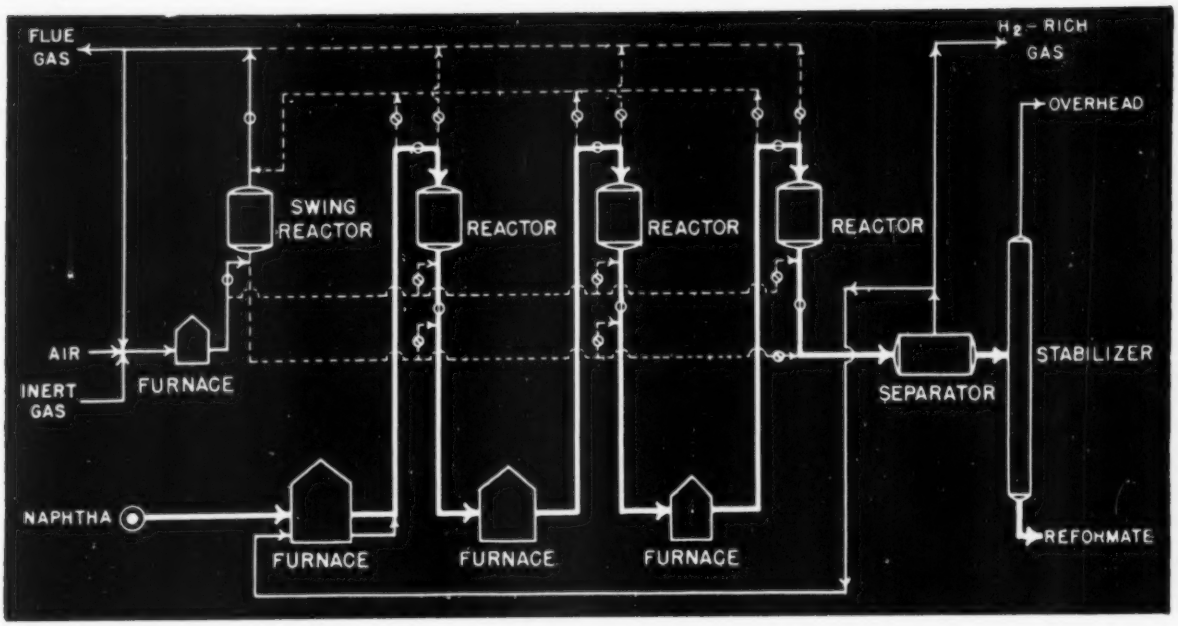

Figure 6. Flow diagram for Ultraforming process.

Typical Ultraforming operation is illustrated in Figure 7. Octane number, gasoline yield relative to that with fresh catalyst, and temperature used to maintain constant octane number are shown as functions of the amount of naphtha processed. These data were obtained in a pilot-plant test to demonstrate commercial reforming of a 200-361 F. Mid-Continent naphtha to the 93-octane level. The operation was carried out at 300 psi and 1.5 volumes of liquid per hour per volume of catalyst. The first cycle was extended to determine how long reforming should be carried out before regenerating. Subsequent cycles were ended when gasoline yield declined 2 percent below the fresh-catalyst level.

The effectiveness of the regeneration technique is also shown in Figure 7. Catalyst activity actually increased a little with each regeneration. Gasoline yield was restored to the level obtained with fresh catalyst. Yield declined in each cycle, but the rate of yield decline remained constant from one cycle to the next. This test has covered seven months of naphtha processing and is still in progress. During this period, thirty barrels of naphtha per pound of catalyst have been processed without any sign of catalyst deterioration.

Yield and Product Quality—As in all reforming processes, yields and octane levels in Ultraforming depend on the type of feed. Gasoline yields from three naphthas of high, moderate, and low naphthene content are shown in Figure 8. From a Gulf Coast naphtha containing large amounts of naphthenes, 100-octane gasoline can be obtained in 93 percent yield. A Mid-Continent naphtha containing moderate amounts of naphthenes yields 93 percent of 95-octane gasoline. An Arkansas naphtha low in naphthenes yields 80 percent of 90-octane gasoline. The complete yield data for these three naphthas are presented in Table 1.

Platinum catalysts have good activity for the conversion of naphthenes to aromatics. But even complete naphthene conversion is not sufficient to produce the high-octane fuels projected for the future. An effective catalyst must also be able to convert paraffins to aromatics. Ultraforming is particularly well suited for this conversion, because of the high activity of the catalyst and the favorable equilibria at low pressure. The ability of Ultraforming catalyst to produce aromatics from paraffins is illustrated in Figure 9, in which aromatics production is shown as a function of octane number for a Mid-Continent naphtha containing 40 percent naphthenes. Conversion of all the naphthenes in 100 volumes of this feed would yield

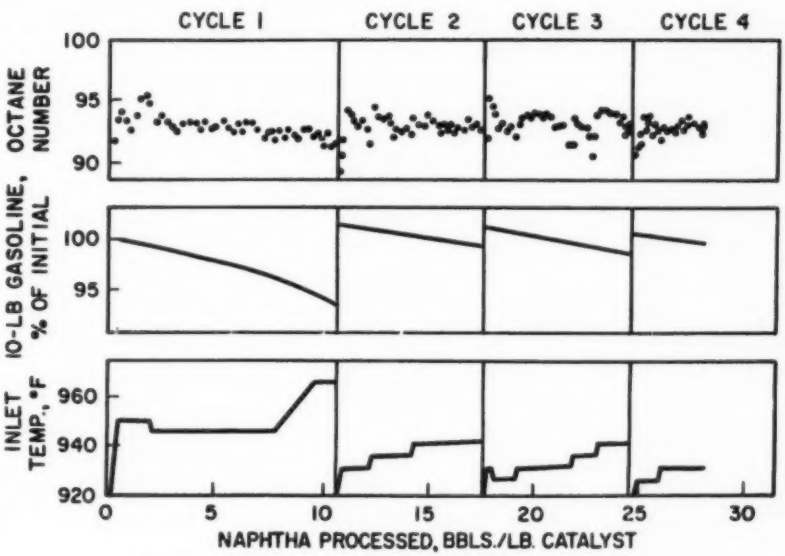

Figure 7. Typical Ultraforming operation (Mid-Continent naphtha).

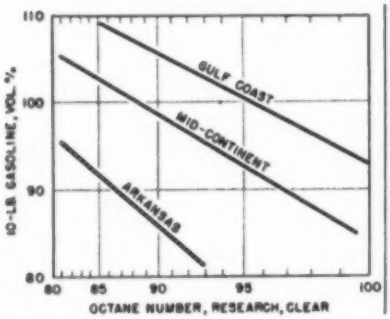

Figure 8. Gasoline yields from different naphthas.

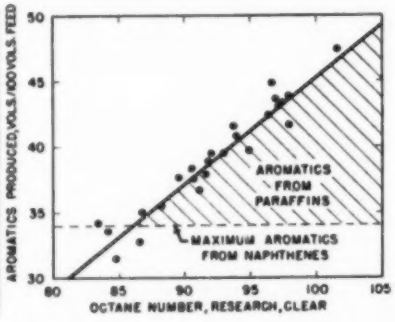

Figure 9. Aromatics production in Ultraforming (Mid-Continent naphtha).

34 volumes of aromatics in addition to those originally present. The reformate would have an octane number of 86. Analysis of many reformates higher than 86 octane number showed that more aromatics were produced than could be obtained from the naphthenes in the feed. These extra aromatics, represented by the shaded area, must come from paraffins. Actual conversion of paraffins to aromatics is somewhat higher than shown because naphthenes are not completely converted.

High conversion of paraffins makes Ultraforming suitable for upgrading low-naphthene charge stocks and also for producing individual aromatic hydrocarbons.

Catalyst Life—The life of a reforming catalyst is best expressed in terms of the amount of naphtha that can be processed per pound of catalyst. It depends on the amount of naphtha that can be processed in each cycle and on the number of cycles the catalyst can be used. Both factors have been studied to determine the life of Ultraforming catalyst.

The amount of naphtha processed per cycle depends on how rapidly catalyst activity and gasoline yield decline in each cycle. Both decline more rapidly at lower pressure, at higher octane level, or when a higher-boiling feed is used. In the demonstration run shown in Figure 7, a 2 percent yield decline allowed a cycle length of 5.6 barrels per pound of catalyst, or 40 days, at 300 psi.

The number of cycles depends on how many times catalyst quality can be restored by regeneration. This has been studied in an aging test in which catalyst deactivation is accelerated by reforming at a pressure of only 100 psi. Catalyst is regenerated after each cycle. The octane number at the beginning of each of 27 successive cycles is given in Figure 10. These data show no decline in catalyst activity from cycle to cycle; in fact, initial activity actually improved somewhat before reaching a constant level. The rate at which octane number declined also improved slightly from one cycle to the next. Initial yield and yield decline in each cycle remained essentially constant throughout the test. The absence of any loss in catalyst quality shows that Ultraforming catalyst should be useful well beyond 27 reforming cycles.

The demonstration run and the accelerated-aging test show that 5.6 barrels per pound per cycle can be processed under fairly severe reforming conditions for well beyond 27 cycles. Life of Ultraforming catalyst at 300 psi should therefore be well beyond 150 barrels per pound.

At 200 psi, less naphtha can be processed per cycle and catalyst life depends more on the number of cycles that can be run. A test similar to the demonstration run has shown that 1.4 barrels per pound can be processed at the lower pressure. Catalyst life at 200 psi should therefore be well beyond 40 barrels per pound. The accelerated-aging test is being continued in an effort to find the practical limit.

Like other platinum catalysts, Ultraforming catalyst deactivates more rapidly with feed stocks of higher sulfur content. The rate of deactivation depends not only on the amount of sulfur in the feed but also on the process conditions needed to reach the desired octane level. Ultraforming regeneration is usually sufficient to compensate for the deactivation caused by sulfur. If the feed has a high sulfur content and if operation at a high octane level is anticipated, sulfur removal may be advisable.

Because of the long life of Ultraforming catalyst, the cost in cents per barrel will be small. Including a credit for the platinum contained in spent catalyst, replacement costs will be about $4 per pound. For operation at 300 psi, the catalyst should therefore cost less than 4 cents per barrel—no more than cracking catalysts.

Commercialization—Three Ultraforming units are under construction: a 9000-barrel-per-day unit for Standard Oil Company (Indiana) at Wood River, Ill.; a 6800-barrel-per-day unit for Pan-Am Southern Corporation at El Dorado, Ark.; and a 21,000-barrel-per-day unit for Pan American Refining Corporation at Texas City, Texas. Other units totalling 17,800 barrels-per-day are being designed for Standard at Casper, Wyo., and Sugar Creek, Mo.

This paper was originally presented at the Western Petroleum Refiners Association annual meeting, San Antonio, March 31, 1954.

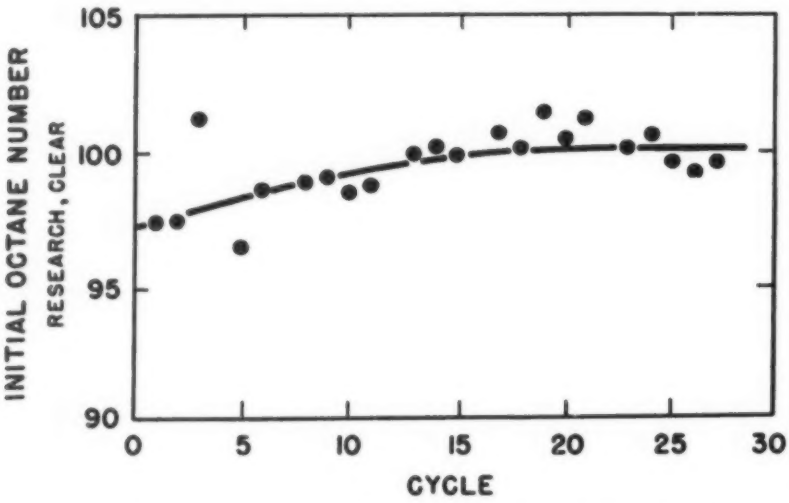

Figure 10. Accelerated aging of Ultraforming catalyst (Mid-Continent naphtha).

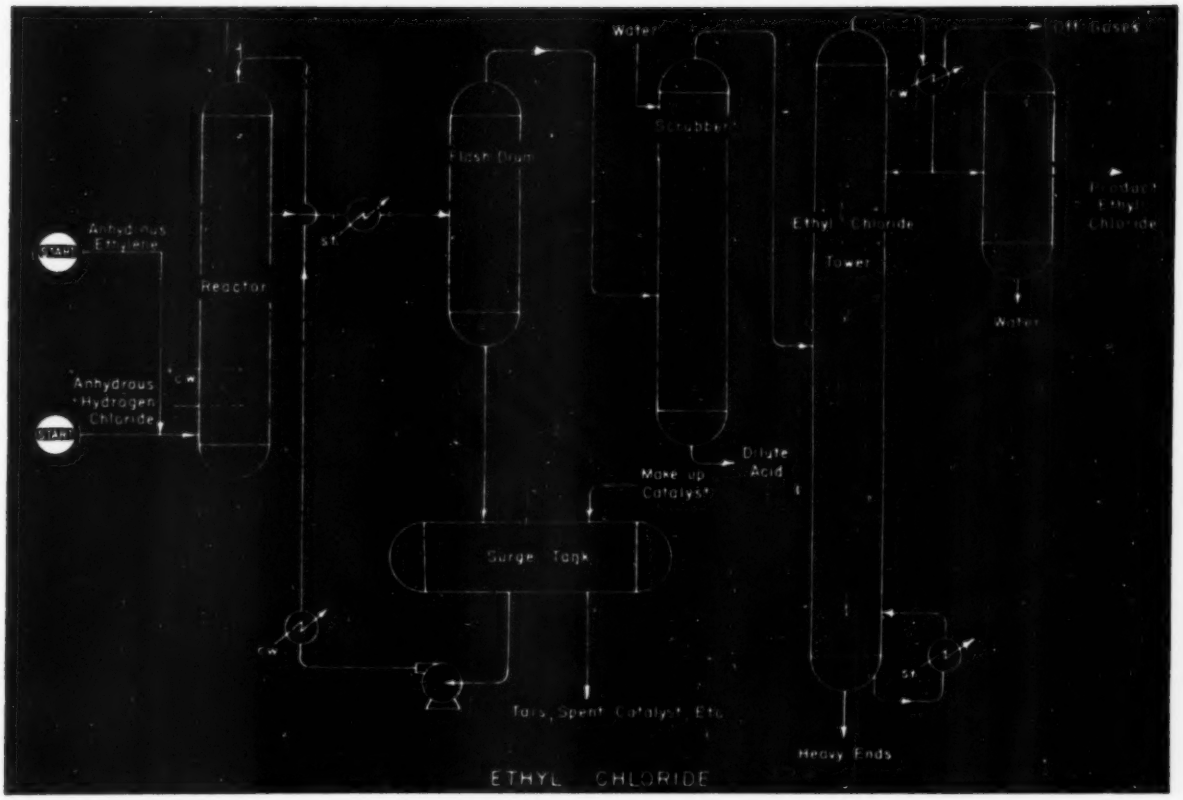

Figure 1. Production of ethyl chloride by the addition of hydrogen chloride to ethylene.

Understanding the chemistry of . . .

Petrochemical Reactions

Part 10. Halogenation of Olefins

Part 11. Addition of Acids to Olefins and Acetylenes

Part 12. The Oxidation of Olefins

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THE ADDITION of acids to olefins and acetylenes is a type of reaction actually and potentially of great importance in petrochemistry. The large scale addition of sulfuric acid to olefins has been discussed in a previous article of this series (Part 9—PETROLEUM REFINER, February, 1954). This reaction is used in the sulfation-hydrolysis process for the production of alcohols from olefins and the intermediate sulfates are of little value other than to be subsequently hydrolyzed to the alcohol with regeneration of the sulfuric acid.

The present article will be concerned with the addition of other acids to both olefins and acetylenes to give compounds used as intermediates and for end uses. There are a fairly large number of different acids which will add, and they include strong mineral acids, weak mineral acids and organic acids. If the unsaturated compound is an olefin, the product will be saturated. As with sulfuric acid, this product is usually an intermediate in the production of other compounds such as tetraethyl lead, ethyl cellulose, ethylene oxide, and glycol. When these compounds are used as intermediates, however, the acid is seldom recovered for immediate reuse.

When the unsaturated compound is an acetylene, the product is a substituted olefin; for example: vinyl chloride ($CH_2=CHCl$), acrylonitrile ($CH_2=CHCN$), and chloroprene ($CH_2=CClCH=CH_2$). These compounds are capable of undergoing further addition but under the conditions used for the initial addition this does not take place to any appreciable extent. The substituted olefins are frequently monomers used in the production of plastics, synthetic rubber, synthetic fibers and soil conditioners.

Addition of Hydrogen Halides (HX)

To Olefins—The ease of addition of hydrogen halides to olefins is dependent upon the nature of the halide and of the olefin. The reactivity of the hydrogen halides is in the order of increasing atomic weight: HI > HBr > HCl. The order of reactivity of the olefins is ethylene < propylene < *n*-butylenes < isobutylene. The addition of hydrogen chloride to the less reactive olefins requires the use of aluminum chloride as a catalyst but anhydrous hydrogen chloride will add to isobutylene at —80 C. and concentrated hydrochloric acid will add at 100 C.

The reaction mechanism involves the formation of an intermediate carbonium ion by the addition of a proton from the acid.

$$CH_3=CHCH_3 + H^+Cl \rightarrow \underset{\text{Carbonium ion}}{CH_3\overset{+}{C}HCH_3} + Cl^-$$

followed by the addition of the chloride ion.

$$CH_3\overset{+}{C}HCH_3 + Cl^- \rightarrow \underset{\text{Isopropyl chloride}}{CH_3CHClCH_3}$$

The proton goes to the carbon atom containing the largest number of hydrogen atoms to give a secondary or tertiary chloride except with ethylene which gives ethyl chloride. With isobutylene the product is *tert.* butyl chloride.

$$CH_2=\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}CH_3 + HCl \rightarrow CH_3\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}ClCH_3$$

The addition of hydrogen bromide is not as clear cut, for the direction of addition is determined by the presence or absence of peroxides. Without peroxides the addition is "normal" while in the presence of peroxides the product formed would indicate that the proton had gone to the carbon atom with the least number of hydrogen atoms—"abnormal addition." This is known as the *peroxide effect* and undoubtedly the reaction goes by a free radical mechanism instead of a carbonium ion mechanism.

$$CH_3CH=CH_2 \xrightarrow{HBr} \begin{cases} \xrightarrow[\text{absent}]{\text{Peroxides}} CH_3CHBrCH_3 \text{ "Normal product"} \\ \xrightarrow[\text{present}]{\text{Peroxides}} CH_3CH_2CH_2Br \text{ "Abnormal product"} \end{cases}$$

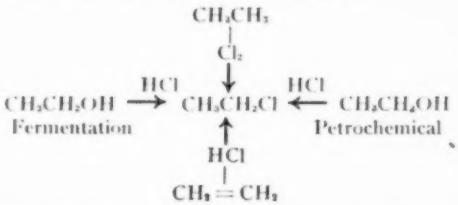
The commercial applications of the addition of hydrogen halides to olefins is confined almost entirely to the production of ethyl chloride from ethylene using anhydrous hydrogen chloride.

$$CH_2=CH_2 + HCl \rightarrow CH_3CH_2Cl$$

This reaction can take place in the vapor phase between 130 and 250 C. or in the liquid phase either in the presence or absence of a solvent. Aluminum chloride is used as a catalyst. In the vapor phase processes the higher temperature ranges are used to obtain an adequate rate of reaction but at temperatures above 250 C. the equilibrium conversion falls off sharply.

Many different processes for the addition of hydrogen chloride to ethylene appear in the patent literature but the process most generally used consists of a tower reactor containing a solution of aluminum chloride in ethyl chloride (or ethylene dichloride or other higher boiling chlorinated solvent) maintained at 35-40 C. under 2.5-3.0 atmospheres pressure. An equimolar mixture of dry ethylene and hydrogen chloride is passed up this tower (Figure 1). A yield of 90 percent is obtained.

The commercial production of ethyl chloride is of interest from an economic standpoint because, in addition to the reaction between ethylene and hydrogen chloride, there are two other methods which may be used.



Ethyl chloride may be produced readily from ethyl alcohol and hydrogen chloride with zinc chloride as the catalyst. The conditions are mild (2 atmospheres and 145 C.) and the yields high. The alcohol may come from either fermentation or ethylene. Ethyl chloride may also be made by the photochemical chlorination of ethane at 100-200 C. to give 85 percent ethyl chloride and 15 percent ethylene dichloride. Most ethyl chloride is made by the addition of hydrogen chloride to ethylene but at least one company is equipped to make it by any one of the three methods with the choice being determined by the relative costs of ethane, ethylene and ethyl alcohol. The principal producers of ethyl chloride are Ethyl Corporation, The Dow Chemical Company and Shell Chemical Corporation.

Ethyl chloride is used for the production of tetraethyl lead and ethyl cellulose. It is also used to a small extent as a refrigerant and as a local anesthetic.

To Acetylene—Acetylene and vinylacetylene are the only two acetylenes to which a hydrogen halide is added commercially and the only halide used is hydrogen chloride. The addition of hydrogen chloride to acetylene has

$$HC\equiv CH + HCl \rightarrow CH_2=CHCl$$

been noted in a previous article of this series (Part 10—PETROLEUM REFINER, March, 1954) as one of the most important methods for the production of vinyl chloride. The reaction is carried out in a vapor phase, multi-tube reactor containing activated carbon pellets impregnated with a catalyst containing mercuric chloride. A 10 percent molar excess of anhydrous hydrogen chloride is used. The hydrogen chloride must be free from water to minimize the formation of acetaldehyde and also to avoid excessive corrosion. The temperature range is between 140-200 C. with the exact temperature being dependent upon the activity of the catalyst. The reaction is exothermal. The yields obtained are 80-85 percent with ethylidene chloride (CH_3CHCl_2) and aldehydes being the major by-products. The ethylidene chloride is formed by the addition of hydrogen chloride to vinyl chloride and acetaldehyde comes from the hydration of acetylene.

$$CH_2=CHCl + HCl \rightarrow CH_3CHCl_2$$
$$HC\equiv CH + H_2O \rightarrow CH_3CHO$$

Vinyl chloride is used to make plastics.

Acetylene can be dimerized to vinylacetylene in the presence of cuprous chloride and ammonium chloride.

$$HC\equiv CH + HC\equiv CH \rightarrow HC\equiv CCH=CH_2$$

Vinylacetylene will add hydrogen chloride to form chloroprene in the presence of the same catalysts.

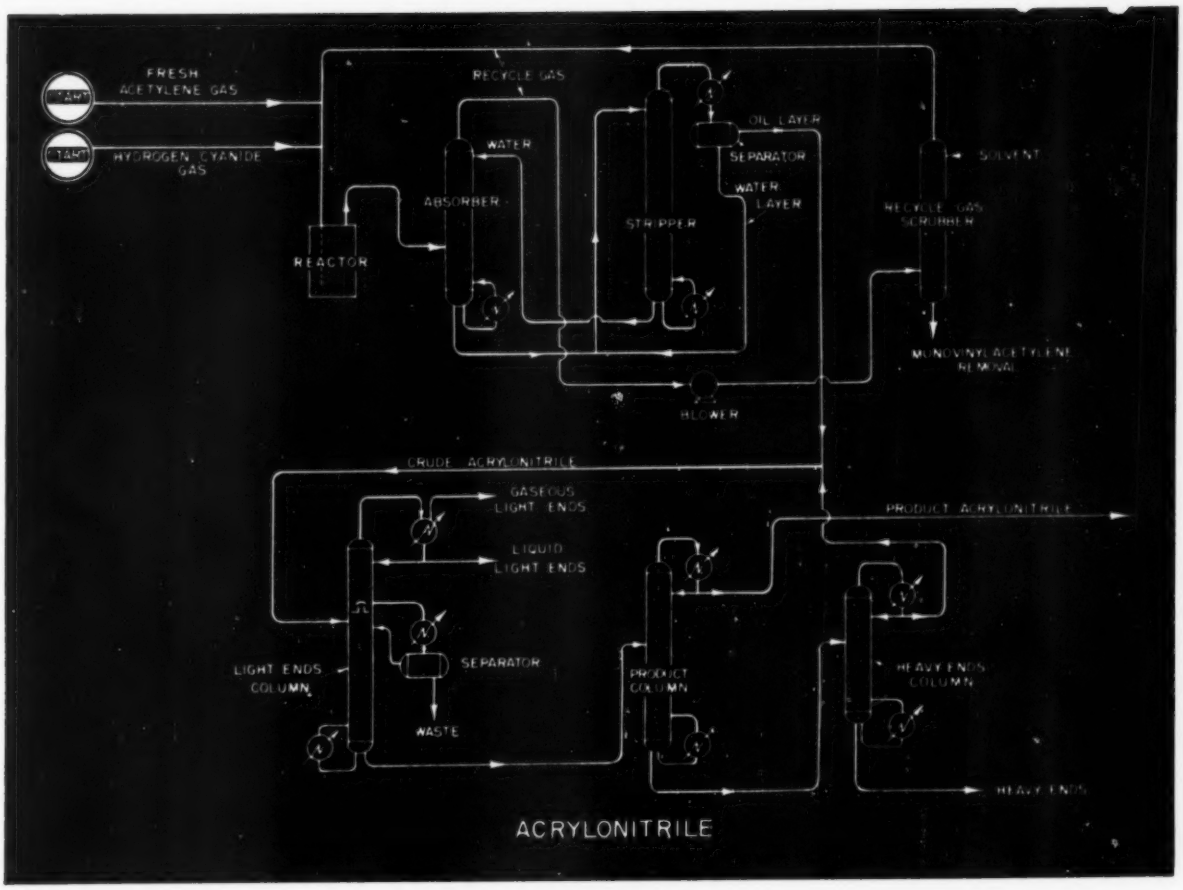


Figure 2. Production of acrylonitrile by the addition of hydrogen cyanide to acetylene.

$$HC \equiv CCH = CH_2 + HCl \rightarrow CH_2 = CClCH = CH_2$$

A tower reactor is used with an aqueous solution of hydrogen chloride, cuprous chloride and ammonium chloride being the continuous phase. The temperature range is 40-65 C. The main by-product is 1,3-dichloro-2-butene ($CH_2CCl=CHCH_2Cl$) formed by the addition of a molecule of hydrogen chloride to the chloroprene.

Chloroprene is polymerized by E. I. du Pont de Nemours and Company to produce neoprene, an oil-resistant rubber first introduced in 1931.

Addition of Hypochlorous Acid (HOCl)

The addition of hypochlorous acid to an olefin is an important reaction of petrochemistry because the chlorohydrins ($RCHOHCHClR$) thus formed are very reactive and useful intermediates. Ethylene chlorohydrin (CH_2OHCH_2Cl) is the most important chlorohydrin because it is used for the production of ethylene oxide and glycol as well as for many other compounds. The value of ethylene chlorohydrin, and other chlorohydrins, in synthesis lies in their bifunctional nature with both a hydroxyl group and a reactive chlorine atom. Because of the reactivity of these functional groups, however, chlorohydrins are not used as solvents.

The preparation of chlorohydrins presents some interesting problems. The hypochlorous acid is formed by the reaction of chlorine and water.

$$Cl_2 + H_2O \rightleftharpoons HOCl + HCl$$

This is an equilibrium reaction with three of the four components being capable of adding to a carbon-carbon double bond. Fortunately the hypochlorous acid adds more rapidly than either the chlorine or the hydrogen chloride. When a slight excess of the olefin is used at a temperature not greater than 60 C. and with a concentration of product not more than 8 percent, the formation of the olefin dichloride is not excessive. The addition of HCl is a problem only with isobutylene and other olefins of this type.

Another method used to reduce dichloride formation is to pass the chlorine into a basic solution which shifts the equilibrium to the right by reaction with the hydrochloric acid.

$$2Cl_2 + Ca(OH)_2 \rightarrow CaCl_2 + 2HOCl$$

This is called *preformed hypochlorous acid* and is obviously more expensive than simply passing chlorine into water.

The mechanism of the addition reaction is similar to that for other acids except that the positive addendum is positive chlorine instead of a proton.

$$CH_2 = CH_2 + HO\,Cl^+ \rightarrow CH_2CH_2Cl + OH$$

$$CH_2CH_2Cl + OH^- \rightarrow CH_2OHCH_2Cl$$

Any chloride ions (Cl^-) in the solution may also add to the carbonium ion to give the dichloride. This side reaction is depressed by using dilute solutions.

The higher molecular weight olefins combine readily with hypochlorous acid to give a mixture of products.

$$CH_3CH = CH_2 + HOCl \rightarrow$$

$$\underset{90\%}{CH_3CHOHCH_2Cl} + \underset{10\%}{CH_3CHClCH_2OH}$$

The ratio of products will vary with the nature of the olefin but the "normal" addition product will always predominate. Hypobromous acid will also add to olefins but the reaction is of little commercial interest at present. Acetylenes are not chlorohydrinated commercially.

Ethylene is chlorohydrinated by two different methods. The first method uses a steel reactor tower lined with rubber and acid-resistant tile and packed with raschig rings. The ethylene and chlorine are blown into the water in the tower at separate points and under 2.5 atmospheres pressure. The reaction is exothermal and a temperature of about 50 C. is maintained. The feed rate is regulated to give an ethylene chlorohydrin concentration of 4.5-5.0 percent.

The two by-products are ethylene dichloride and β,β'-dichlorodiethyl ether ($ClCH_2CH_2OCH_2CH_2Cl$). The latter compound can be made the main product by passing an excess of ethylene and chlorine simultaneously into ethylene chlorohydrin at 80 C.

$$CH_2OHCH_2Cl + CH_2 = CH_2 + Cl_2 \rightarrow ClCH_2CH_2OCH_2CH_2Cl + HCl$$

This ether is a good solvent and soil fumigant and it also finds some use in the synthesis of other compounds (morpholine, divinyl ether, etc.).

The other method for the synthesis of ethylene chlorohydrin uses a solution resulting from the reaction between slaked lime and chlorine. The temperature is essentially 25 C., the pressure 200 atmospheres and the chlorohydrin concentration is maintained at 35-40 percent.

The corrosion problems are great with both of these methods and special resistant equipment must be used.

Ethylene chlorohydrin may be separated from its dilute water solution by first obtaining its water azeotrope (42.5 percent chlorohydrin, b.p. 97.8 C.) then salting out a 70 percent chlorohydrin solution. Terniary distillation with benzene or other drying agent may then be used. Because the principal use of ethylene chlorohydrin is to produce ethylene oxide, most of the chlorohydrin is not separated but converted directly to the oxide from its water solution. For this use ethylene chlorohydrin is in competition with the direct oxidation of ethylene.

Addition of Hydrogen Cyanide to Acetylene

Hydrogen cyanide will not add to olefins under ordinary conditions but will add readily to acetylene to give acrylonitrile.

$$HC \equiv CH + HCN \rightarrow CH_2 = CHCN$$

This addition reaction constitutes the ultimate reaction in the production of acrylonitrile from natural gas and air. The acetylene is obtained by the partial oxidation of natural gas and the hydrogen cyanide is produced by the reaction of ammonia, air and natural gas. The other method has limestone and coal as the raw materials for the production of the hydrogen cyanide with ethylene oxide the other major reactant. This latter method of acrylonitrile production will be discussed in detail in the next article of this series (Part 12).

Acrylonitrile may be produced by either a liquid phase or a gas phase reaction between acetylene and hydrogen cyanide. In the liquid phase reaction acetylene and hydrogen cyanide in a mole ratio of 10 to 1 are charged to a rubber lined reactor containing an aqueous catalyst solution of cuprous chloride (Figure 2). A pressure of slightly more than one atmosphere is maintained and the temperature is 80 C. The yield of acrylonitrile based on HCN is 85 percent and 75 percent based on acetylene. The catalyst solution is similar to that used to dimerize acetylene so it is not surprising that some of the acetylene is lost through vinylacetylene formation. Some of the acetylene is also hydrated to acetaldehyde.

Monsanto Chemical Company and American Cyanamid Company produce acrylonitrile by the "natural gas process." Carbide and Carbon Chemicals Company uses the ethylene oxide process. Acrylonitrile is used to produce synthetic fibers and soil conditioners.

Addition of Organic Acids (RCOOH)

To Olefins—The addition of an organic acid to an olefin would appear to be a simple, one step process for the preparation of esters $(RC(=O)-OR')$ from olefins.

$$CH_2 = CH_2 + CH_3COOH \rightarrow CH_3C(=O)-OCH_2CH_3$$
Ethyl acetate

The reaction does not go well with ethylene, however, but with higher olefins the reaction goes easily at moderate temperatures to give fairly good yields of esters of secondary or tertiary alcohols.

$$CH_3CH = CH_2 + CH_3COOH \rightarrow CH_3C(=O)-OCH(CH_3)_2$$
Isopropyl acetate

Sulfuric acid is generally used as the catalyst but various other catalysts are suggested in the patent literature. The petrochemical importance of this reaction is more potential than actual.

To Acetylenes—The production of vinyl acetate by the addition of acetic acid to acetylene is of considerable importance with an annual production of approximately 100 million pounds of vinyl acetate by this method.

$$HC \equiv CH + CH_3COOH \rightarrow CH_3C(=O)-OCH = CH_2$$
Vinyl acetate

By minor changes in conditions another molecule of acetic acid can be added to the vinyl acetate to give ethylidene diacetate.

$$CH_3C(=O)-OCH = CH_2 + CH_3COOH \rightarrow (CH_3C(=O)-O)_2CHCH_3$$
Ethylidene diacetate

Various organic acids may be used with acetylene and its derivatives. Strong acids are used as catalysts with or without mercury salts. Vinyl acetate is prepared by a gas phase reaction over zinc acetate or other catalyst on charcoal at 200 C. or above. Ethylidene diacetate is made by passing acetylene into glacial acetate acid in the presence of mixed mercury sulfate-mercury acetate catalyst at a temperature between 60-85 C. This process is frequently modified to produce both vinyl acetate and ethylidene diacetate.

The main use of vinyl acetate is to produce polymers. Aqueous dispersions of these polymers are used as adhesives, textile finishes, etc. Vinyl acetate copolymers are used as soil conditioners, water paints, modified concrete and flooring compositions. Polyvinyl alcohol and polyvinyl acetols are also obtained from polyvinyl acetate. Ethylidene diacetate is converted to acetic anhydride and acetaldehyde by distillation in the presence of 1 to 3 percent sodium pyrophosphate or zinc chloride. This constitutes one of the standard methods for the production of acetic anhydride.

End of Part 11. Part 12 will appear in an early issue.

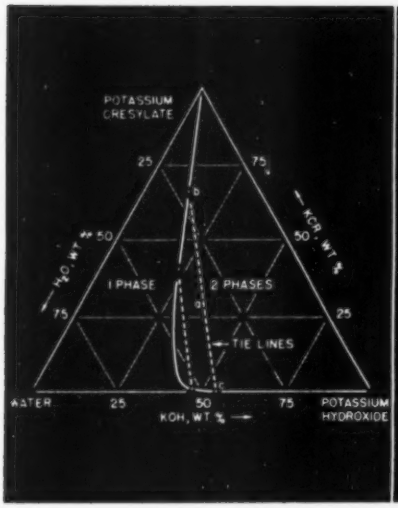


Figure 1. Phase diagram for KOH-KCR-H_2O.

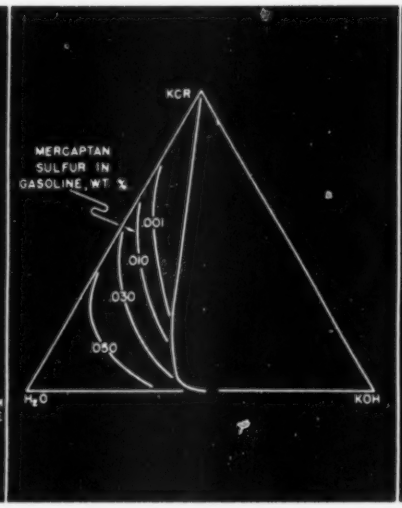


Figure 2. Mercaptans in West Texas Gasoline at equilibrium with treating solution.

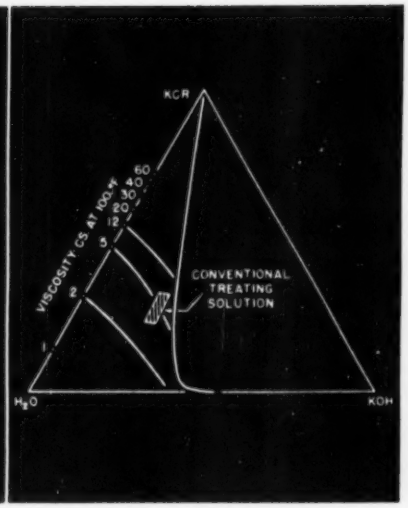


Figure 3. Viscosity of KOH-KCR-H_2O solution.

Dualayer Gasoline Treating Process

Complete mercaptan removal is possible with this process which utilizes the two immiscible layers of caustic solutions containing organic acids.

G. A. Duval and V. A. Kalichevsky,
Magnolia Petroleum Company,
Beaumont, Texas

EXTRACTION OF mercaptans from petroleum products is preferable to their conversion to disulfides because of the reduction in sulfur content of the treated distillates. Disulfides left in the oil may be even more harmful to oil quality than the original mercaptans.[2] The importance of complete removal of mercaptans from gasoline as compared to their conversion to disulfides may be visualized from data presented in Table 1.

These data show that in treating gasolines normally encountered at a refinery savings of $160 of TEL per thousand barrels are not unusual because of an increase in the octane number of the leaded gasoline. In many instances considerably greater savings can be obtained depending on the quantity of mercaptans present and the desired octane number of the product. The Dualayer process obtains a doctor sweet product by extracting mercaptans and not converting them to disulfides which remain in the oil.

Mercaptans are acidic and alkalies react with them. However, alkalies alone are seldom capable of extracting all mercaptans with the possible exception of the lightest members of the series. Complete removal of mercaptans from petroleum distillates with conventional aqueous alkali hydroxides is attained only in very rare instances.

TABLE 1
Typical Tel Savings for Dualayer Process Over Doctor Treating

Gasoline	Octane, R-39 + 3cc TEL		TEL Savings* Per 1000 Bbls
	Doctor	Dualayer	
Absorption	84.0	85.6	$ 90
Thermal	83.2	86.0	$160
Straight-run	85.9	87.2	$ 70

* TEL @ 2.31 cents per cc

The addition of organic acids, referred to as solutizers or solventizers,[3] improves the mercaptan extraction efficiency of aqueous alkali hydroxide solutions. However, improvement obtained by existing processes is seldom adequate to insure sufficient removal of mercaptans to give products sweet to the doctor test.

Investigation of caustic solutions containing organic acids revealed that at certain concentrations two immiscible layers are formed which are also immiscible with the oil. Commercial processes now in use employ

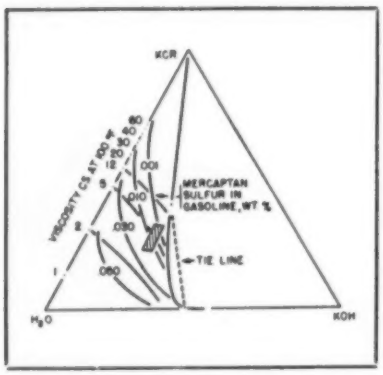


Figure 4. Mercaptans in gasoline at equilibrium and viscosity of treating solution.

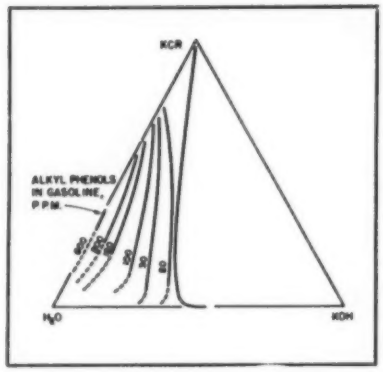


Figure 5. Alkyl phenols in gasoline at equilibrium with treating solution.

one-phase solutions of composition fairly remote from this critical region in order to avoid such separations. The new process developed at Magnolia Petroleum Company utilizes the two layers and is referred to as the Dualayer (dual layer) process. The principles on which the process is based are applicable to a large variety of systems involving alkali hydroxides, water and organic substances. For illustration purposes, the system consisting of potassium hydroxide, water and cresylic acid was selected.

Potassium hydroxide has a considerable advantage over sodium hydroxide for extraction of mercaptans. On account of their low viscosity, potassium hydroxide solutions can be used commercially in highly concentrated form. The mercaptan extraction power of these concentrated solutions is high. Losses of potassium hydroxide due to entrainment are less than with sodium hydroxide because of this difference in viscosity. For this reason, in regenerative processes the cost of potassium hydroxide is usually less than that of sodium hydroxide and the extractive power is greater.

Cresylic acid is a mixture of acidic organic substances present in the petroleum distillates from which the mercaptans are removed. Caustic solutions extract these compounds and no outside source is normally required to supply them to the process. In the few instances where distillates are deficient in these acids, they may be obtained from treating other refinery stocks. Composition of cresylic acid from petroleum varies with the nature of the distillate but these variations are minor and do not affect the process efficiency.

Three-component systems are conveniently represented by triangular diagrams. A typical diagram for potassium hydroxide, water and potassium cresylate system is given in Figure 1. In this instance cresylic acids extracted from catalytically cracked gasolines were employed. Cresylic acids from other sources may slightly affect the position of the boundary line separating the one- and two-phase regions. The tie line *a* on the diagram shows the composition of the two layers if the total composition of the mixture corresponds to any composition intersected by the line. The actual compositions of the two layers are represented by points *b* and *c*.

In choosing the most desirable composition of the treating solution for commercial use, several factors must be taken into consideration. The most important of these are the extraction power for mercaptans and viscosity.

Extraction power of solutions for mercaptans may be visualized from concave curves on Figure 2. They show that the extraction efficiency improves as the curves approach the two-phase region. It also improves with the change in composition of the treating solution as it nears the KCr apex of the triangular diagram given in Figure 2. In the diagram KCr is used as an abbreviation for potassium cresylate and H_2O and KOH are the conventional chemical symbols for water and the uncombined potassium hydroxide.

Viscosities of the solutions are represented by the convex curves on Figure 3. Viscosities decrease as the curves approach the H_2O apex of the diagram. Separation of treating solution from the treated distillate is a function of the viscosity of the treating solution. Good separation is obtained with solutions having viscosities below 12 centistokes at 100° F. Solutions of considerably higher viscosity can be used successfully with proper mixing and settling equipment and with continuous filtration of the solution to remove impurities.

Figure 4 shows that for a given viscosity the highest extraction efficiency is obtained by a solution having a composition on the two-phase boundary line. This is true for viscosities above 5 centistokes at 100° F. Extraction efficiency and viscosity lines in Figures 2 and 3 are superimposed in Figure 4.

Equilibrium curves for cresylic acid concentrations in the treating solution and in gasoline are shown in Figure 5. These curves are important for calculating the amount of cresylic acids introduced with the fresh distillate that will be absorbed by the treating solution or released to the distillate.

The shaded regions on Figures 4 and 5 represent compositions of conventional treating solutions recommended for use commercially at the present time. It may be seen that the ultimate ability of these solutions for extracting mercaptans has not been utilized. This is also demonstrated by the data presented in Table 2 on mercaptan extraction by the Dualayer and conventional solutizer solutions from a West Texas straight-run gasoline.

The data are presented on percentage basis for better visualization. The 100 percent removal of mercaptans corresponds to a product sweet to the doctor test and containing less than 0.0005 weight percent mercaptan sulfur.

The tabulated data show the ease with which the mercaptans are removed from the oil by the Dualayer process. With the conventional treating solutions, the doctor sweet products could not be obtained even by raising the solution to distillate ratio more than twenty times above that employed in the new process.

The exceptional performance of the Dualayer process is due to the fact that the potassium hydroxide, potassium cresylate and water content of the treating solution are completely

TABLE 2

Mercaptan Removal by Dualayer and Solutizer Solutions From West Texas Gasoline

Treating Solution	Solution to Gasoline Ratio Vol	Mercaptan Removal % One Stage	Two Stages	Three or More Stages
Dualayer	0.02	91	100	100
Solutizer	0.20	71	80	93
	0.40	84	93	96

NOTE: Initial Mercaptan Sulfur = 0.110 Wt %

under control. Treating solution composition on conventional solutizer units is normally out of control and reaches an unfavorable equilibrium for mercaptan extraction. The water content or boiling point of the solution is usually the only method used to adjust composition and the potassium hydroxide to potassium cresylate ratio varies until it reaches equilibrium with the organic acids in the oil. The resulting solution is deficient in potassium hydroxide and is relatively ineffective for the extraction of mercaptans. High treating ratios and large strippers are required with this type of solution for even partially satisfactory results. In the Dualayer process the water content and the potassium hydroxide content are both controlled. The water content is controlled by the stripper temperature and the potassium hydroxide content by the equilibrium with the potassium hydroxide-water layer in the equilibrium drum. Since the solution consists of only three major components, control of two of them automatically controls the third. In other words, the Dualayer solution has only one degree of freedom and the stripper temperature controls its composition. Conventional solutions, with only one homogenous phase, have two degrees of freedom and cannot be controlled satisfactorily by the stripper temperature alone.

Regeneration of the Dualayer solutions is easy. Less than ten pounds of steam per barrel of gasoline charge was needed in the pilot unit to remove mercaptans from the treating solution used in the experiments reported in Table 2. Several modifications of the regeneration procedure are possible. The co-existence of three layers— gasoline, potassium hydroxide and potassium cresylate—in equilibrium with respect to mercaptan concentrations shows that either of the two alkali layers will reduce the mercaptan content of the gasoline. However, the favorable equilibrium conditions are established on account of the tremendous absorptive capacity of the potassium cresylate layer for potassium mercaptides. In the absence of the potassium cresylate layer, mercaptans distribute relatively even between the gasoline and potassium hydroxide solution and their extraction becomes difficult. If the spent potassium hydroxide solution from treating is brought in contact with the potassium cresylate layer, mercaptans are absorbed by this layer and the potassium hydroxide solution regenerated.

Regeneration of mercaptans from the potassium cresylate layer is accomplished by diluting with water and steam stripping the diluted solution.

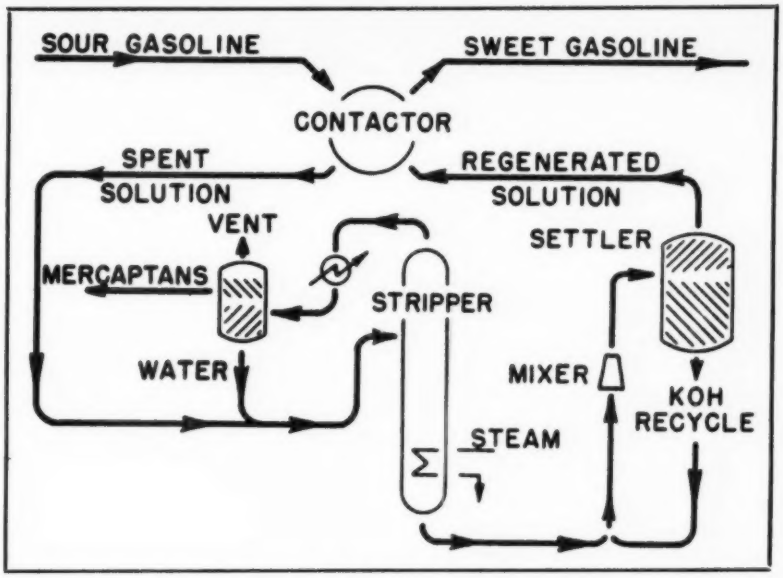


Figure 6. Simplified flow diagram for Dualayer process.

Since the required potassium cresylate to gasoline treating solution dosage is very low, in some cases it may be as low as 2 volume percent, only a small quantity of water is required to provide very dilute solutions for stripping. The advantages of stripping dilute solutions may be visualized from Figure 2. The ease of stripping is inversely proportional to the mercaptan extraction ability of the solution and water dilution reduces the mercaptan extraction power of the solution.

A typical flow diagram for a commercial process is shown in Figure 6. It is only one of the possible variations of the flow of materials which was found to be the best for solving a particular refinery problem. Gasoline distillate containing mercaptans enters two-stage countercurrent extraction system *A*. The small quantity of the treating solution employed favors the use of mixing and settling stages in preference to tower extraction. The doctor sweet gasoline is pumped to storage and the spent treating solution is diluted with an equal volume of water and settled in equipment now shown to remove small quantities of entrained gasolire. The diluted solution is directed to the regeneration tower *B* equipped with closed steam coils. Water, added to the treating solution in the previous step, is converted into stripping steam by the closed steam coils. It is removed as a liquid on the water separation tray in the upper portion of the column and used for diluting the stream of the spent solution.

Vapors from the stripper are condensed and the mercaptans are withdrawn from the system from *C*. The water layer is returned to the top of the stripper tower. The lean treating solution is blended with a small quantity of 50° Be′ potassium hydroxide solution and fed to the Dualayer equilibrium drum *D*. The two layers are separated, and the top layer, which contains the potassium cresylates, is used as the treating solution. Small quantities of potassium cresylate solution may be withdrawn from the system if excessive quantities of cresylic acid are present in the raw gasoline distillate. The unit described above is under construction at Magnolia Petroleum Company's Beaumont refinery.

The use of the Dualayer process is not limited to gasoline but it can be applied successfully to the refining of considerably heavier petroleum distillates, such as kerosine, and distillate fuel oils, which are not treated satisfactorily with conventional mercaptan extraction processes. Application of the Dualayer principle to improving the long term storage properties[1] of catalytic distillate fuel oils will be described in another paper in the near future.

Original presentation of this discussion was before the annual Western Petroleum Refiners Association meeting, San Antonio, March, 1954.

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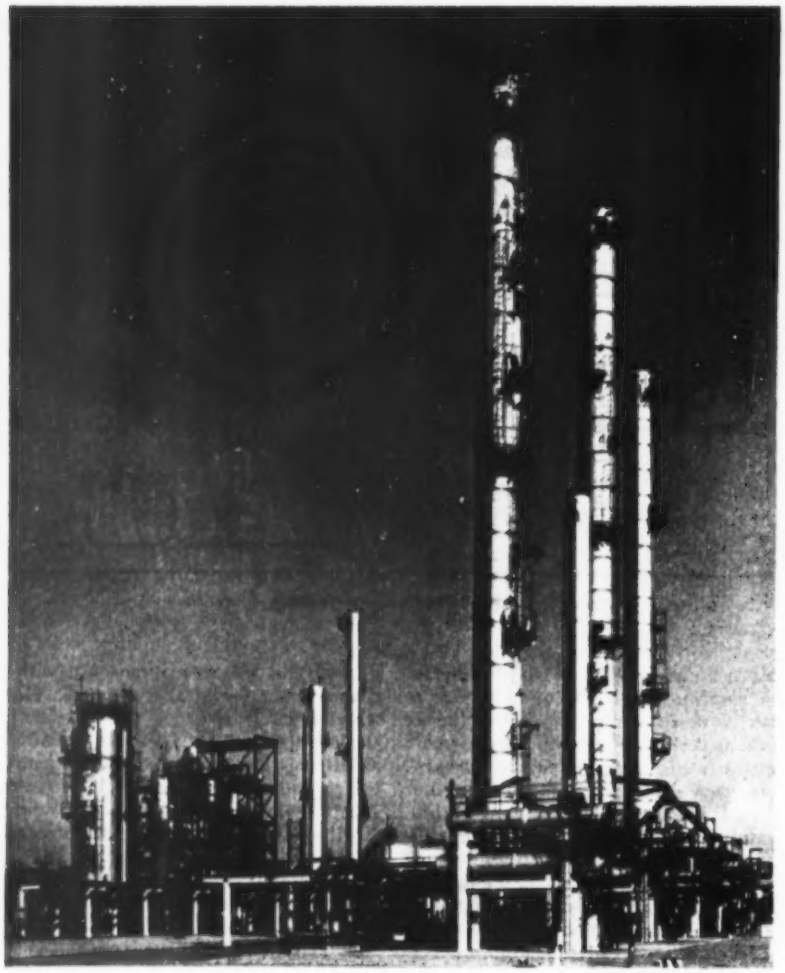


Phenol plant: First step is cumene.

All the way . . .

Phenol from Petroleum

No chlorine or sulfuric acid are required in Socal's process unit at Richmond to produce phenol from 100 percent petroleum sources.

SUCCESSFUL production of phenol derived for the first time directly from 100 percent petroleum sources has been announced by Standard Oil Company of California.

Output of this valuable industrial chemical from a recently-completed plant will be marketed by Oronite Chemical Company, a subsidiary of Socal.

The new plant went on stream last month at Standard's Richmond refinery after more than two years of process development, engineering and construction. It is designed for an annual output of 35 million pounds of phenol, and some 20 million pounds of acetone, which also will be marketed through Oronite.

Addition of this unit to the petrochemical manufacturing section of Standard's Richmond refinery reflects the growing Western market for these products.

The new plant is the first one in the United States to use a new synthesis process licensed by Hercules Powder Company. Customarily, phenol is produced from benzene by processes which utilize critical defense chemicals such as sulphuric acid and chlorine. The process being used at Richmond is designed to operate on a cumene feedstock manufactured at Standard's El Segundo refinery from propylene and benzene, both produced in turn from petroleum.

The process starts with the liquid-phase reaction of propylene and benzene using phosphoric acid catalyst to produce cumene. This step in the process, carried out at El Segundo, was designed and licensed by California Research Corporation, another Standard subsidiary. Cumene is a versatile chemical itself and was used extensively during World War II as a component for aviation fuel.

The second step in the process involves the air oxidation of cumene to cumene hydroperoxide which, in turn, goes through acid cleavage to yield phenol and acetone. Over-all phenol yield is about 80 percent and a typical ratio of reaction products is, 57 parts phenol, 34 parts acetone, 6 parts alpha-methyl styrene and 3 parts acetophenone.

This process is outstanding because it requires no chlorine or sulfuric acid. These chemicals are used in present commercial phenol processes and may be in short supply.

Consumption of phenol has shown steady growth in the chemical industry for the past 30 years. Present end uses are: 60 percent for phenolic resins for laminated wood, wood waste boards, and for rock wool and glass wool insulation binders; 25 percent for other chemicals such as 2, 4-D acid salicylic acid; 10 percent for miscellaneous solvent extractions and the remainder for export. Standard of California is itself a large consumer of phenol.

Principal uses of phenol are in the manufacture of plywood adhesives and resins for molded plastic parts. The chemical is also used as an intermediate in the manufacture of dyestuffs, insecticides and many other compounds.

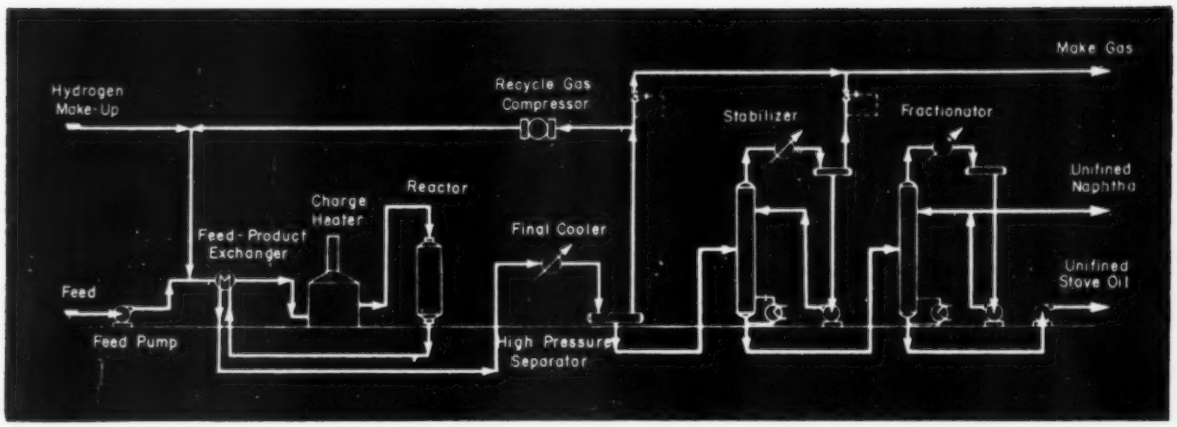


Figure 1. Simplified flow diagram of the Unifining process.

New data on . . .

Unifining

This catalytic hydrogenation process can clean up a variety of refinery stocks by nearly complete removal of sulfur, nitrogen and metals.

H. W. Grote and C. H. Watkins, Universal Oil Products Company, Des Plaines, Ill.
H. F. Poll and G. W. Hendricks, Union Oil Company of California, Los Angeles

THE IDEAL SOLUTION to handling low-grade crudes is the substantial removal of the troublesome constituents: sulfur, nitrogen, and metals without loss of the hydrocarbons with which they are combined. At present, catalytic hydrogenation is the only reasonable method for accomplishing such removal. Widespread use of hydrogenation techniques in the oil industry has been impractical however due to the difficulty of providing adequate supplies of low cost hydrogen. This situation has been changed completely during the last five years by the commercial application of catalytic reforming. The widespread installation of catalytic reforming processes has made available to refiners tremendous quantities of low cost by-product hydrogen.

This cheap hydrogen has stimulated research work on various hydrorefining processes; particularly active in the field have been both Universal Oil Products Company and Union Oil Company of California. Results of research and development activities of these two organizations have been combined in the Unifining process and made available through a single licensing arrangement to the petroleum industry. One commercial unit is now in operation and several more will be brought on stream before the end of this year.

Unifining is a process which permits the refiner to improve economically the quality of a variety of refinery stocks. This improvement is obtained by hydrogenation over catalysts containing cobalt and molybdenum, resulting in the nearly complete removal of sulfur, nitrogen, and metals. In addition, when applied to cracked distillates, olefins are saturated and oxygen compounds are decomposed resulting in greatly improved stability of the Unifined products. The new technique differs from usual refining processes in that these improvements are obtained with little or no yield loss; volumetric recoveries above 100 percent are common. The Unifining process is applicable to a wide variety of distillate stocks. These include various types of:

(1) Gasolines, both straight-run and cracked.

(2) Virgin and cracked middle distillates which can be converted to high quality kerosenes, stove oils, and Diesel fuels.

(3) Higher boiling fractions, such as high sulfur gas oils, heavy coker distillates, and catalytic cycle stocks.

Chemistry—The chemistry of Unifining is essentially that of selective hydrogenation. In removal of contaminants, it involves the controlled breaking of the molecular chain or ring at the point where the sulfur, nitrogen, or oxygen atom occurs. This breaking is caused by the introduction of hydrogen with evolution of hydrogen sul-

Typical Unifining Reactions

Table 1 - Sulfur Compounds

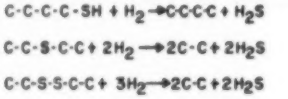
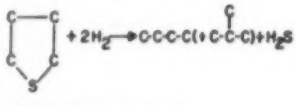
Reaction	H_2 Requirement CF/mol
1. C-C-C-C-SH + H_2 → C-C-C-C + H_2S	379
2. C-C-S-C-C + $2H_2$ → 2C-C + $2H_2S$	758
3. C-C-S-S-C-C + $3H_2$ → 2C-C + $2H_2S$	1137
4.  (Tetrahydrothiophene)	758
5.  (Thiophene)	1516

Table 2 - Nitrogen Compounds

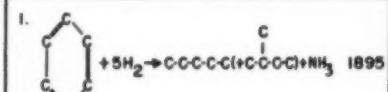
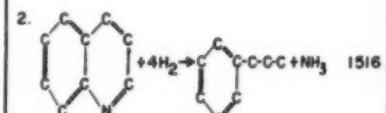
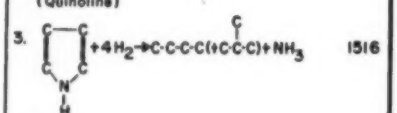
Reaction	H_2 Requirement CF/mol
1.  (Pyridine)	1895
2.  (Quinoline)	1516
3.  (Pyrrole)	1516

Table 3 - Oxygen Compounds

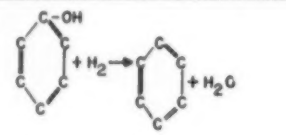
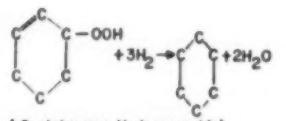
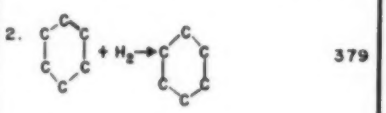
Reaction	H_2 Requirement CF/mol
1. 	379
2.  (Cyclohexene Hydroperoxide)	1137
3. $C_7H_{13}OOH + 3H_2 \rightarrow C_7H_{16} + 2H_2O$ (Heptene Hydroperoxide)	1137

Table 4 - Olefinic Compounds

Reaction	H_2 Requirement CF/mol
1. C=C-R + H_2 → C-C-R (+ isomers)	379
2. 	379

Tables 1, 2, 3 and 4

fide, ammonia, or water. The resultant hydrocarbon reaction product usually remains either as one or more aliphatic hydrocarbons, or as an alkyl group on an aromatic or naphthenic hydrocarbon. These hydrocarbon reaction products usually have larger liquid molecular volumes than do the parent sulfur, nitrogen, or oxygen containing reactants. Due to the fact that negligible cracking of carbon to carbon bonds occurs, the yields of liquids from most such Unifining operations are in excess of 100 volume percent of the charging stock.

Table 1 gives several typical reactions of sulfur compounds, and it can be seen that, depending on the type of sulfur compound involved, the hydrogen consumptions may vary from one up to four moles of hydrogen per mole of reactant. Table 2 gives similar data for three types of nitrogen compounds, and it can be seen that the hydrogen requirements are again rather substantial per mole of nitrogen compound. In this connection, it should be borne in mind that the nitrogen compounds usually occur in considerably lower concentrations than do sulfur compounds. Oxygen containing compounds occur in many cracked stocks, the predominant types being those generally classed as phenols as well as various hydroperoxides. Table 3 gives typical reactions of such oxygen containing compounds.

Of prime importance in the chemistry of Unifining are the various reactions of olefinic hydrocarbons. This importance is due to their high concentration in normal cracked distillates, resulting in substantial consumption of hydrogen in the Unifining of cracked stocks. Table 4 gives typical chemical reactions of olefinic materials during Unifining. It can be seen that, depending on the type of olefin, either aliphatic or naphthenic hydrocarbons may result. In this connection it is of interest to note that frequently in excess of 50 percent of the olefins present in thermally cracked stocks are converted by Unifining to naphthenes indicating a rather surprising concentration of cyclic olefins in thermally cracked materials.

Unifining Process—Unifining is a particularly versatile refining tool. It may be applied to fractions of wide boiling ranges—from gasolines to heavy vacuum distillates. Such charging stocks may be of straight run or cracked origin, of high sulfur content or low. The objectives of Unifining include:

(1) Improvement in odor and color stability.

(2) Pretreatment of catalytic reformer charge stocks.

(3) Reduction in sulfur and nitrogen compounds.

(4) Improvement in burning properties, cetane number and susceptibility to catalytic cracking.

One particularly useful application of Unifining is the simultaneous preparation of catalytic reformer feed and high grade stove oil by the processing of coker distillates. An equipment arrangement for such an operation is shown in Figure 1. The feed is combined with hydrogen recycle gas, preheated by heat exchange with reactor products, and heated to the required reactor inlet temperatures. On passing through the reactor the desired catalytic reactions are accomplished and, depending on the specific application, these may occur in either vapor phase or mixed phase conditions. The reaction products, after heat exchange, are cooled and flow to a high-pressure separator. The hydrogen rich gas from this separator is recycled back to the reactor; any excess over process requirements being vented to fuel. The high-pressure separator liquid flows to a stabilizer for removal of dissolved light gases and is shown in this figure as a conventional refluxed stabilizer. In other specific applications this stabilizer may be replaced by a stripper, rectified absorber, or other comparable equipment. The stabilized product is then ready for fractionation as indicated in this flow diagram, or may be utilized directly.

The extensive laboratory development of the process was carried out in high pressure, continuous flow bench scale apparatus. The development necessary to demonstrate the use in Unifining of by-product hydrogen from

catalytic reforming required fully integrated pilot plant equipment.

The Unifining reactions consume hydrogen, consequently make up hydrogen is required. Chemical hydrogen consumption for Unifining amounts to six to eight cubic feet per barrel for each unit of reduction in bromine number plus an additional fifty to one hundred cubic feet per barrel for each unit of reduction in weight percent sulfur. Other hydrogen consuming reactions are usually small for petroleum feeds. As a practical matter the actual plant consumption of hydrogen is always somewhat in excess of the chemical requirements. The total hydrogen required depends not only on the chemical properties of the feed, including the specific types of sulfur compounds present, but also on the purity of the hydrogen supplied, and on the detailed process design of the particular Unifining plant. In designing, economic considerations set the efficiency of hydrogen utilization. Experience indicates that chemical consumption of hydrogen may range up to 90 percent of that supplied with as little as 10 percent being vented as "bleed gas."

The Unifining reactions are exothermic and in some cases the charge heater is used only during start-up periods. Unifining can employ a wide range of process conditions. The selection of optimum process conditions is based upon the nature of the feed stock, the desired quality of products, and on economic considerations. The majority of commercial Unifiners will operate at pressures below 1000 pounds, and at temperatures ranging up to 800 F.

The Unifining catalyst contains cobalt and molybdenum supported on alumina. It has specific activity for promoting the reactions desired in Unifining at processing conditions which suppress undesirable side reactions. It is relatively unaffected by those constituents of charging stocks, recycle gases, and regeneration gases, which are known poisons for many of the catalysts used in other refining processes. The catalyst is normally employed in the form of physically rugged cylindrical tablets. It has been demonstrated to be extremely stable at temperatures far above those encountered in conventional catalytic refining processes; depending upon the stock processed and on the conditions employed, the catalyst remains active without regeneration for on-stream periods as long as a year or more. However, if and when regeneration is desirable it can be accomplished by simple combustion of the catalytic coke.

Applications of Unifining—The Unifining process may be applied to distillate stocks of any boiling range. For convenience of discussion, its application to naphthas, mid-barrel distillates, and high end point stocks will be described.

Naphtha Stocks

Unifining when applied to the processing of gasolines or naphthas may be used to accomplish several objectives. It can be used to desulfurize straight run or certain cracked gasolines. Simple desulfurization of such stocks permits refiners to blend them into products meeting stringent stability and sulfur specifications providing the octane ratings of such blends are adequate. This type of Unifining is also useful in the production of special premium quality products such as solvent naphthas having rigid sulfur and odor limitations. Typical results of several Unifining operations on straight-run naphthas are given in Table 5. These data show that regardless of crude source or raw naphtha sulfur content, sweet products containing only 10 to 20 ppm of total sulfur result from such processing.

In the catalytic cracking of high sulfur gas oils, the raw catalytic gasoline usually contains sulfur compounds exceeding specification limits. In addition, while of adequate unleaded octane rating, such stocks frequently require some sulfur removal treatment to improve the antiknock quality after addition of tetraethyl lead. In most cases the lower boiling fractions of high sulfur catalytically cracked gasoline can be economically treated by simple conventional means. However, in a number of refineries, the heavy catalytic naphtha is of such a nature that sulfuric acid treating is required to produce a marketable product meeting both sulfur and stability specifications. Acid treatment of such stocks is both expensive to carry out, and results in substantial volumetric losses.

Table 6 gives data on the Unifining of such a heavy catalytic naphtha in a mixture with heavy thermal naphtha which was carried out at rather mild conditions to obtain a low sulfur, mercaptan free, gum stable motor fuel blending stock. The sulfur and potential gum contents were reduced 83 and 93 percent at a volumetric yield in excess of 101 percent. No loss in leaded blending octane number was suffered.

Pretreatment of charge stocks prior to catalytic reforming is another of the many useful applications of Unifining. The catalytic reformer produces the hydrogen required by the Unifiner, and the Unifiner in turn utilizes a portion of the hydrogen to remove sulfur, nitrogen, and other undesirable components of the reformer charge. With normal straight run naphthas being extensively upgraded by catalytic reforming, the refiner's attention has been directed to certain gasoline stocks which for one reason or another are not choice feeds for available catalytic reforming processes. Among such materials are straight run naphthas of abnormally high sulfur, nitrogen, and metals contents and a wide variety of thermally cracked naphthas and coker gasolines. Unifining provides the refiners with a tool for the economical processing of these marginal quality stocks into

TABLE 6
Unifining California Mixed Thermal and Catalytic Heavy Naphthas
Mild Operation

	Charge	Unifined Product
Liquid Yield (C_5+), Volume Percent of Charge		100
Gravity, API	40.2	41.5
ASTM Distillation, °F Initial	256	244
10 Percent	284	281
50 Percent	332	331
90 Percent	384	382
Maximum	414	410
Sulfur, Weight Percent	0.52	0.09
Bromine Number	18.1	5.8
Nitrogen, ppm	660	410
Diolefins, Weight Percent	0.9	0.1
Phenols, Weight Percent	0.3	nil
Copper Dish Gum, mg./100 ml.	42	2.8
Blending Octane Numbers Research, clear	87.0	81.0
Research, +3.0 ml. TEL/gallon	90.0	90.0
Motor Method, clear	76.0	73.0
Motor Method, +3.0 ml. TEL/gallon	79.5	81.0
Hydrogen Consumption (Chemical), SCF/bbl. of charge	120	

TABLE 5
Unifining of Straight-Run Naphthas

SOURCE	Kuwait		West Texas		California	
SAMPLE	Charge	Product	Charge	Product	Charge	Product
Gravity, API	54.3	54.4	58.9	60.6	47.1	47.2
Distillation						
I.B.P. °F.	260	260	153	131	272	278
10%	273	273	184	174	288	296
50%	298	298	230	226	305	306
90%	350	349	282	281	331	335
E.P. °F	378	380	330	326	364	370
Sulfur, Wt. Percent	0.078	0.0011	0.15	0.0016	0.141	0.0022
Bromine No.			5.8	0.4	1.0	0.4
Yield, Vol. Percent		100.0		100.4		99.9
Chemical Hydrogen Consumption, CF/B	10-20		50		15	

ideal catalytic reformer feeds. With a Unifined feed stock the simplest type of catalytic reforming installation is all that is required. The Unifining results of Table 5 indicate that the products, in addition to being suitable for the preparation of specialties, are also prime feed stocks for catalytic reforming. Such treatment is particularly desirable when catalytic reforming operations are carried out at high severities yielding products of 90-100 F-1 clear octane ratings. The benefits obtained by Unifining such straight-run feeds for catalytic reforming units are principally those of eliminating sulfur and metals from the naphthas. Nitrogen is also frequently present to an appreciable extent in straight run naphthas ranging up to 15 ppm, and when thus encountered is readily removed by Unifining.

Thermally cracked stocks of various types are available to the industry in very large quantities. Cracked gasolines have been in the past the backbone of the refiner's gasoline blends, but, first, with the extension of catalytic cracking facilities to all scales of refinery operations, and, second, with the widespread adoption of catalytic reforming processes, thermal gasolines are now of inadequate quality to be blended off in any but minor concentrations when producing premium fuels. The volume of such material continues to be significant for, in spite of new catalytic cracking units replacing a certain amount of thermal capacity, new thermal cracking installations continue to be made, largely to process heavier crude residues than were formerly handled. This trend toward heavier charging stocks to thermal operations such as viscosity breaking and once-through coking, has also gradually reduced still further the quality of thermal gasolines.

Unifining of thermally cracked gasolines allows the removal of sulfur, nitrogen, oxygen, and metals, while simultaneously saturating olefins and diolefins. By this treatment the undesirable materials are eliminated without destruction or loss of the parent hydrocarbons, which fact accounts for the extremely high liquid recoveries enjoyed with Unifining operations. Thus results a prime quality feed for catalytic reforming from what otherwise would be an uneconomic or, at best, an incremental charge stock whose tolerable concentration would be definitely limited.

Table 7 gives the results of Unifining of thermally cracked stocks. One is derived from Oklahoma crude and is of moderate sulfur content, but high in olefins and very high in arsenic content compared to straight run feeds. The Unifined product is of low bromine number and sulfur content and the arsenic has been completely removed, while enjoying a liquid yield of 102 volume percent. The other data of this table show the application of Unifining for pretreatment of a high sulfur heavy cracked naphtha blend to prepare it for Platforming. After processing 61 barrels of the 440-EP charge naphtha per pound of catalyst in non-regeneration operation, the run was giving a product containing only 50 ppm of sulfur and 5 ppm of nitrogen on the 380 F. EP product fraction. In another similar test, 104 barrels of feed per pound of catalyst were processed and at this catalyst service, the total liquid product contained only 150 ppm sulfur.

The over-all hydrogen production balance for combined operation of a Unifining unit with a catalytic reforming installation provides a useful excess of hydrogen. One of the most attractive means of using this hydrogen is to include in the Unifiner feed, cracked or straight run material boiling above the gasoline range. By this technique, it is possible to separate from the Unifiner effluent a kerosine or diesel fuel fraction of unusually good quality. In Table 8 are given data from pilot plant operations carried out while Unifining a blend of straight run and coker distillates boiling up to 460 F. About 90 cubic feet of hydrogen per barrel of Unifiner feed was required for sulfur and olefin reduction. The product from the Unifining operations was split into two fractions—a 400 F. EP Platformer charge stock and a 400 to 500 F. fuel oil cut of excellent stability characteristics.

Mid-Barrel Stocks

Unifining is an attractive means of producing premium kerosenes, stove oils, diesel fuels and other mid-barrel distillates. The data of Table 9 indicate the application of this process to such fractions.

On Unifining a high sulfur Wyoming diesel oil a six point increase in cetane number was obtained with 93 percent reduction in sulfur content. The small reduction in average boiling point results, not from the cracking of carbon to carbon bonds, but from the conversion of high molecular weight sulfur compounds to lower boiling hydrocarbons. The data on the processing of stove oil given in Table 9 illustrates the improvement in color, sulfur content, and odor that can be achieved by Unifining. The data indicate substantially complete removal of mercaptans, 95 percent reduction in total sulfur content and an improvement in color from +21 to +30 Saybolt without significant change in boiling range.

TABLE 7

Unifining Cracked Gasolines

Severe Operation

	Oklahoma		California Mixed Thermal and Straight-Run Heavy Naphtha		
	Charge	Unifined Product	Charge	Unifined Product	380° F E.P. Fraction of Unifined Product
Gravity, API	49.1	51.0	46.1	51.1	52.6
ASTM Distillation, °F Initial	215	214	221	196	195
10 Percent	246	244	257	249	242
50 Percent	300	298	313	310	296
90 Percent	370	365	390	385	353
Maximum	408	436	440	446	379
Sulfur, Weight Percent	0.12	0.008	1.9	0.008	0.005
Bromine Number	67	3.5	20	<1	0
Nitrogen, ppm			130	10	5
Arsenic, ppb	320	<1			
Liquid Yield, volume Percent		102.3		101	90
Chemical Hydrogen Consumption, CF/B		420		435	

TABLE 8

Unifining of 460° EP Distillate

	Unifiner Products				
	Unifiner Feed	Total	Platformer Charge	Stove Oil Component	Platformate
Gravity, API	50.7	50.6	52.2	42.4	46.7
Distillation I.B.P., °F	246	271	261	431	126
10 Percent	276	287	280	433	188
50 Percent	323	331	313	440	291
90 Percent	405	413	363	463	365
E.P., °F.	460	463	405	502	450
Sulfur, Weight Percent	0.107	0.0011	0.0007	0.023	
Bromine Number	12.9	0.4	0.4	0.5	
Basic Nitrogen, ppm	25.9	1	<1	2	
Total Nitrogen, ppm	43.1	1	<1		
Arsenic, ppb	27	<1			
Saybolt Color				+20	
Steam Jet Gum as Produced				1	
After 4 months at 100°F				1	
F-1 Octane, Clear					89.8
F-1 Octane +3 cc TEL gallon					98.2
Yield, Volume Percent of Unifiner Feed	100	100.0	85.9	14.1	
Yield, Volume Percent of Platformer Chg.			100		84.0
Chemical Hydrogen Consumption, CF/B		90			

TABLE 9
Unifining Straight Run Middle Distillates

	Wyoming Diesel		Montana Stove Oil	
	Charge	Unifined Product	Charge	Unifined Product
Gravity, API	31.3	34.8	42.3	42.8
ASTM Distillation, °F Initial	452	260	363	360
10 Percent	523	492	399	390
50 Percent	560	547	427	420
90 Percent	603	596	474	474
Maximum	640	644	550	542
Total Sulfur, Weight Percent	2.1	0.14	0.18	0.010
Mercaptan Sulfur, ppm.			240	0.8
Cetane Number	46	52		
Color, Saybolt			+21	+30
Liquid Yield (C$_5$+), volume Percent of chg.		101		100
Chemical Hydrogen Consumption, CF B	140		25	

TABLE 10
Unifining Cracked Middle Distillates

	Vis-breaker Distillate		Catalytically Cracked Cycle Oil	
	Charge	Product	Charge	Product
Gravity, API	37.3	39.2	26.0	30.0
Distillation IBP, °F	365	350	451	301
10 Percent	411	404	483	442
50 Percent	450	446	531	518
90 Percent	510	507	587	588
E.P.	563	567	618	624
Sulfur, Weight Percent	.45	.02	1.15	.18
Bromine Number	45	3.0	19	8
Aromatics + olefins, Percent	58.9	29.1	50.4	48.9
Yield, Volume Percent		101.3		101.3
Color, ASTM Union Color Initially	5	Lt. 1	1	1
After 6 months Storage	5	1	4½	3
Gum, Steam Jet, mg/100 ml. Initially	10	1	7	2
After 6 months Storage	24	1	54	3
Chemical Hydrogen Consumption, CF B	330		190	

By Unifining cracked middle distillates, products are obtained having properties which approach those usually associated with virgin distillates from sweet crudes. In Table 10 are given data on the processing of a highly olefinic visbreaker distillate which was Unifined under conditions intended to give almost complete sulfur removal, and it can be seen that substantial improvements in both color and gum contents have been obtained. In addition measurements made on the charge and product after six months dark storage at 100 F. indicate that the product has excellent stability characteristics.

The data of Table 10 dealing with the Unifining of a catalytically cracked cycle oil indicate that when this operation was carried out to a less complete degree of sulfur removal, the product does not have quite as satisfactory stability characteristics as those obtained from the more severe operation on visbreaker distillates. The degree of improvement by Unifining is of course dependent on many variables such as types of feed stock, boiling range, and process conditions.

Unifining Heavy Distillates

The treatment of heavy distillates, both cracked and straight run, to obtain catalytic cracking charge stocks of higher quality is another attractive application. Products from such operations can also be used in the preparation of premium quality distillate fuel oils.

In Table 11 data are presented on the Unifining of a variety of heavy distillates. In the Unifining of a 26.9 API gravity Santa Maria coker distillate containing 3.9 weight percent sulfur, the liquid yield was in excess of 100 volume percent with the reduction in sulfur being over 98 percent. It can also be seen that removal of nitrogen was 79 percent. In general, the removal of nitrogen from high boiling distillates is more sensitive to changes in processing conditions than is desulfurization.

The remaining two feed stocks of Table 11 are of about the same gravity but of quite different origin one being a virgin heavy vacuum gas oil, the other a catalytically cracked cycle oil. On processing these two stocks under conditions resulting in about 30 percent desulfurization, both materials are improved to a degree which would permit their economic use as catalytic cracking feed components.

Further data on the upgrading of a low quality catalytic cracking feed stock are given in Table 12. The data show sulfur and nitrogen reductions by Unifining of approximately 99 and 78 percent, respectively. Catalytic cracking runs were made on the 410-800 F. fractions from both the Unifiner charge and product. Unifined fraction yielded 45 percent more gasoline and 38 percent less catalytic coke.

This type of operation, an alternate to the Unifining of heavy catalytic naphtha, has the advantage of maintaining better cracking catalyst selectivity along with the production of low sulfur products.

Processing Coker Distillates from Non-Petroleum Sources

In Table 13 are given data illustrating the application of Unifining for the processing of two unusual coker distillates. One of these materials was produced by coking the raw bitumen recovered from Athabaska tar sands while the second was obtained by coking of crude Colorado shale oil. By Unifining the tar sands coker distillate which is estimated to comprise about 50 percent of sulfur containing compounds, a product is

TABLE 11
Unifining Heavy Distillates

	Santa Maria Coker Distillate		Heavy Vacuum Gas Oil		Catalytically Cracked Cycle Oil	
	Charge	Unifined Product	Charge	Unifined Product	Charge	Unifined Product
Gravity, API	26.9	39.0	23.6	27.2	22.7	25.8
ASTM Distillation, F. Initial	210	170	576	440	612	558
10%,	318	285	674	600	631	612
50%,	569	467	793	760	658	651
90%,	870	722	879	870	693	696
95%,	901	759				
Maximum			902*	894*	740	748
Sulfur, Weight Percent	3.9	0.05	1.94	0.39	1.37	0.26
Bromine Number		5			9	5
Nitrogen, Weight Percent	0.24	0.05				
Liquid Yield, Volume Percent		102		100.4		100.0
Chemical Hydrogen Consumption, CF B	840		170		150	

* 97 Percent Over.

TABLE 12
Unifining and Catalytic Cracking of San Joaquin Valley Coker Gas Oil

	Total Unifiner Charge	410-800 F Fractions	
		Unifiner Charge	Unifiner Product
Unifining			
Liquid Yield, volume Percent of Unifiner Chg.		74	74
Gravity, API	15.5	17.7	22.6
ASTM Distillation Initial, °F	510		
10 Percent, °F	624		
50 Percent, °F	712		
74 Percent, °F	800		
Sulfur, Weight Percent	0.88	0.83	0.01
Nitrogen, Weight Percent	0.52	0.44	0.095
Catalytic Cracking of 410-800 F Fractions			
Conversion, volume Percent of Chg. Disappearance		36.5	40.0
Cracked Gasoline, volume Percent of Cracking Chg		21.6	31.4
Catalytic Carbon, Weight Percent of Cracking Chg		7.6	4.7
Gasoline-Carbon Ratio		2.8	6.7

obtained which is equivalent to a corresponding mixed cut from sweet crude. Unifining of the shale oil distillate which contained the very unusual nitrogen content of 1.4 weight percent resulted in a product which contained only 40 ppm of nitrogen. From this product a diesel fuel fraction was distilled having a 63-cetane rating. With such large quantities of contaminants present in these last samples, it should be appreciated that hydrogen consumption is greater than when Unifining less extreme feed stocks. With adequate attention to this fact, Unifining thus provides for the effective utilization of such otherwise impractical feeds as crude shale oils and tar sands distillates.

Economics of Unifining—Unifining is a relatively low-cost catalytic process, from the standpoint of both capital investment and operating charges. Although cases have been evaluated which can justify the cost of installing a plant to produce hydrogen, Unifining shows particularly rapid payout where fuel-gas-value hydrogen from a catalytic reformer may be available within the refinery. The hydrogen in excess of that required for pretreatment of catalytic reformer charge stocks may be utilized for sweetening and gum-stabilizing of cracked gasoline; for improving the product properties of mid-barrel stocks, such as color, odor, stability, burning properties, cetane number, sulfur and nitrogen content; for the preparation of premium catalytic cracking charge stocks or for premium fuel oils.

The specific application of any refinery process requires careful economic evaluation by the refiner. The versatility that characterizes Unifining makes a "specific illustration" of economics less realistic than usual. It is apparent from the previous discussion of the process and of its applications that for different charge stocks and different product objectives the detailed economics will vary considerably.

This results from:

(1) The wide potential range of process variables that may be employed.

(2) The significant differences in plant design which result from considerations of flexibility and hydrogen utilization, and

(3) Values assigned to feeds and products.

Over a wide range of Unifining applications it is estimated that erected plant costs (boundary limits) for a 5000-barrel-per-stream-day Unifiner would vary from $75 to $175 per barrel of daily thruput.

The typically low capital and operating costs for two Unifining applications are illustrated in Table 14. They are both based on 5000-barrel-per-stream-day Unifiners. Case I covers the processing of a wide range, high sulfur, cracked naphtha. The objective is to combine pretreatment of catalytic reformer charge together with production of high quality stove oil or diesel oil blending stock from a fraction otherwise suitable only for a residual fuel oil cutter stock. Case II pertains to a much simpler type of installation for the upgrading of a poor quality distillate into premium diesel fuel.

It may be noted from Table 14 that the simpler plant for producing diesel fuel of Case II costs $425,000 and the operating costs are only 8.1 cents per barrel; compared to a capital cost of $750,000 and operating costs of 11.9 cents per barrel for Case I which produces both catalytic reformer feed and high quality fuel oil.

Commercialization—Based on the proven performance of the Unifining process in laboratory and pilot plant units, a number of refiners have already adopted the Unifining process. United Refining Company of Warren, Pennsylvania announced the successful initial operation of the first commercial Unifining Unit on February 19, 1954. This unit is designed to process 750 barrels per stream day of many fractions, including kerosine and various mineral oils, producing highly stable, essentially sulfur-free, premium products.

Some of the other installations are Unifiner-Platformer combinations which will both allow economical reforming of low grade stocks, and also provide for future flexibility in choice of charge stocks. In all, eight units are in operation, under construction, or in design, with a total design capacity of over 80,000 barrels per day. The charge stocks to these units range in sulfur content up to 1.3 weight percent, in nitrogen content up to 150 parts per million, and, in certain cases, contain substantial amounts of metals. Several of the Unifiner-Platformer combinations will charge a feed with a portion boiling above 400 F. which is converted in the Unifining process to a premium quality component for No. 1 fuel or kerosine. These refiners will thus economically solve the problem of producing marketable products from low quality, unstable fuel oil fractions. A considerable number of additional Unifining units are in various stages of study, design, and engineering.

The authors gratefully acknowledge the efforts of the technical staffs of Union Oil Company of California and Universal Oil Products Company whose work contributed to the content and preparation of this paper. This paper was presented at the Western Petroleum Refiners Association annual meeting, San Antonio, March 31, 1954.

TABLE 13
Unifining Non-Petroleum Coker Distillates

	Tar Sands Coker Distillate		Colorado Shale Oil Coker Distillate	
	Charge	Product	Charge	Product
Gravity, API	16.0	26.2	33.2	44.9
Distillation I.B.P., °F.	111	108	165	156
10 Percent	398	330	336	278
50 Percent	776	684	518	450
90 Percent	958*	791*	635	602
Percent Over	82.5	97.5		
Percent Bottoms	17.5	2.5		
Sulfur, Weight Percent	4.06	.36	.87	.01
Bromine Number	50	10		2
Nitrogen, Weight Percent			1.44	.004
Conradson Carbon, Weight Percent	6.8	1.02		
Characterization Factor, K	11.1	11.5		
Yield, Volume Percent		101.0		102.0
Cetane Number of Diesel Fraction				63
Chemical Hydrogen Consumption, CF/B	800†		1000†	

* 80 Percent Over
† Approximate

TABLE 14
Unifiner Costs

	Case I 5000 B/SD Reactor Charge (mixture of high-sulfur, cracked and straight run naphthas, 210-500 F.) Stabiliser and Splitter included to produce Cat. Ref. feed and fuel Oil.	Case II 5000 B/SD Reactor Charge (400-650 °F. Straight run) Steam Stripper included for diesel fuel product
Estimated Plant Cost	$750,000	$425,000
Operating Costs, cents/bbl		
Labor @ $2.75 per hr.	2.6	1.9
Utilities		
Fuel @ 15 cents/MmBtu		
Power @ .8 cent/Kwh		
Steam @ 30 cents/M lb.		
Water @ 2 cents/M gallon		
Total	2.8	2.0
Catalyst	<2.0	<2.0
Hydrogen Consumption @ 15 cents/MmBtu	1.5	.5
Maintenance @ 4 Percent Labor and Materials	1.8	1.0
Insurance and Property Taxes @ 2½ Percent	1.2	.7
Total Operating Cost Excluding royalty, depreciation, administration and overhead.	11.9	8.1

New Pebble Heater Process

Yields of ethylene and acetylene are maximized through

• Higher temperatures • Shorter contact time • Lower pressures

M. O. Kilpatrick, L. E. Dean, D. S. Hall, K. W. Seed,
Phillips Petroleum Company,
Bartlesville, Okla.

A NEW PROCESS tool, called the "Pebble Heater," has been developed by Phillips Petroleum Company for light hydrocarbon cracking and high temperature superheating. This unit was developed to obtain the higher yields of ethylene and acetylene which result from higher temperatures, shorter contact times, and lower pressures than normally realized in tube cracking furnaces. While cracking n-butane, the yield of ethylene is 50 percent greater than has been realized in tube furnaces. Cracking an ethane-rich feed gives a yield of ethylene plus acetylene 25 percent greater than tube furnaces. This yield is obtained at 91 percent ethane conversion which is generally considered to be unattainable in tube furnaces. Superheating temperatures as high as 2500 F. are practical.

Process Description—The pebble heater proper consists of two refractory-lined vessels positioned one above the other and connected by a refractory-lined 7-inch diameter duct or throat. In the top vessel, called the preheater, pebbles are heated by direct contact with high temperature combustion gases. In the lower vessel, called the reactor, the hot pebbles from the preheater are contacted in counter-current flow with the material to be superheated or cracked.

The remainder of the unit consists of the pneumatic pebble lift, effluent quench vessels, combustion air blower and auxiliary equipment. Small refractory pebbles are used as the heat transfer medium. These pebbles are approximately $\frac{3}{8}$-inch spheres and were developed specifically for this use. The unit now being operated by Phillips at Borger, Texas, is a 30-million-Btu-per-hour heater which for several years has been operated experimentally to perfect mechanical and process design and to evaluate various feed stocks.

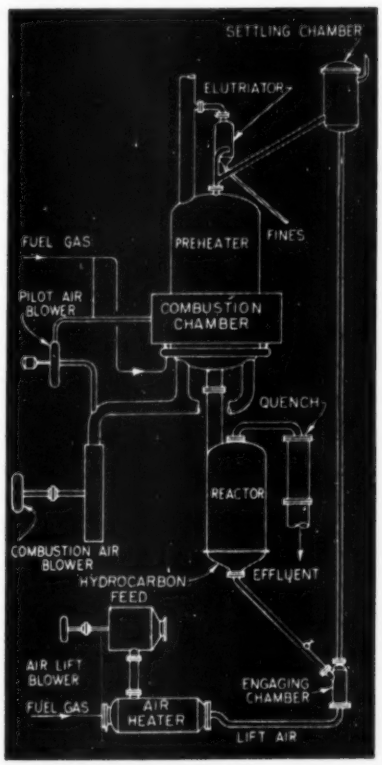


Figure 1. Phillips pebble heater.

Figure 1 is a schematic drawing of the pebble heater and shows more clearly the component parts of the unit. A bed of contiguous pebbles extends from the top of the preheater, through the throat and the reactor, and down to the engaging chamber of the pneumatic lift. The entire bed of of pebbles moves slowly downward through the preheater and reactor at a rate set by a flow control device in the engaging chamber. In the engaging chamber the pebbles fall into a stream of heated air and are elevated through the lift line to the settling chamber. Here the pebbles disengage from the lift gases and return by gravity to the top of the pebble bed in the preheater. As the pebble bed moves downward through the preheater, the pebbles are heated by an upward flow of hot combustion gases which are generated under pressure in the circumferential combustion chamber. In the reactor, the downward moving hot pebbles are contacted directly by the upward flowing gaseous charge for heating or cracking. To withstand the cyclic heaing and cooling and the mechanical handling, the pebbles must be resistant to thermal and mechanical shock and to abrasion, as well as being capable of withstanding high temperatures.

After several years of development work and close cooperation with pebble manufacturers, satisfactory pebbles have been developed for pebble heater use. Continuous elutriation is provided to prevent a build-up in the circulating pebble bed of the small quantity of pebble fines and chips produced. This is accomplished by a damper located in the stack which forces a stream of flue gas from the preheater through a vertical portion of the pebble transfer duct between the settling chamber and the preheater. The fines thus removed from the main pebble stream are separated from the gases in a small cyclone and returned to the ground.

As originally constructed, this unit had a bucket elevator to return the pebbles from the reactor outlet to the preheater top; however, because of excessive maintenance and high pebble breakage, the elevator was replaced with the pneumatic lift. This lift has operated very satisfactorily with negligible maintenance and low pebble breakage.

The combustion chamber is operated at pressures up to 5 psig, and an air

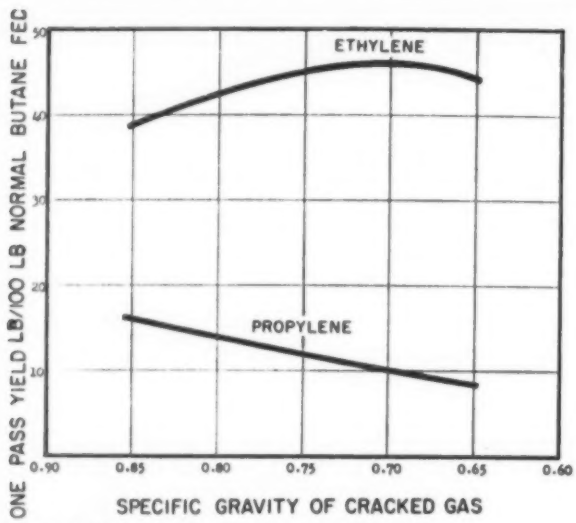


Figure 2. Yields of products from cracking n-butane pebble heater.

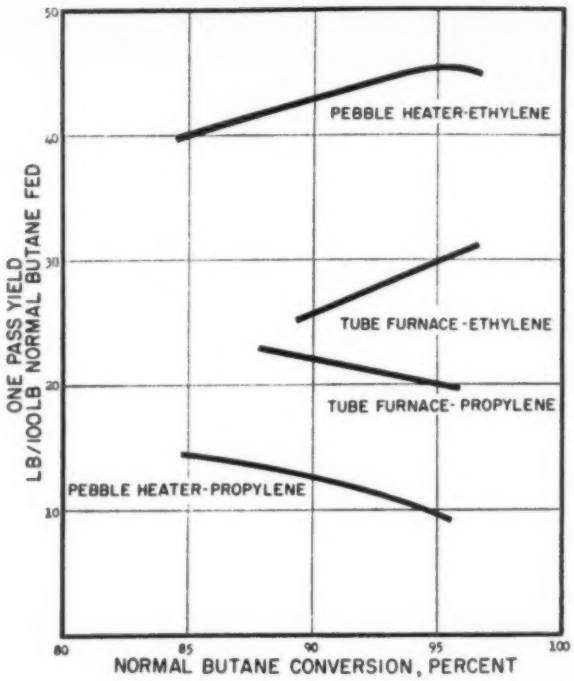


Figure 3. Yields of products from cracking normal butane.

blower is provided to raise the combustion air to this pressure. In the combustion chamber, natural gas is burned in multiple burners to provide a uniform combustion gas temperature completely around the preheater pebble bed.

Hydrocarbon feed is admitted to the lower portion of the reactor through a distributor designed to provide uniform pebble flow and uniform feed distribution. Cracking depth is controlled by means of reactor effluent temperature or gravity. The cracked gases pass out the top of the reactor into a primary quench vessel where the temperature is quickly reduced to about 400 to 700 F. by direct water spray. In a second vertical quench tank the effluent temperature is lowered to about 125 F. The gases then pass through an oil spray, a scrubber, and a mist extractor to remove the small quantity of tars and oils which do not drop out in the water quench system.

A small pressure differential is maintained between the bottom of the preheater and the top of the reactor to prevent the undesirable mixing of combustion products and cracked hydrocarbon gases. In addition, steam is injected into the throat between the chambers to maintain a flow of steam in both directions. A steam seal is also utilized in the pebble duct between the reactor and the engaging chamber to prevent mixing of hydrocarbon feed and lift gases. Both of these seals are easily maintained and present no operational problems.

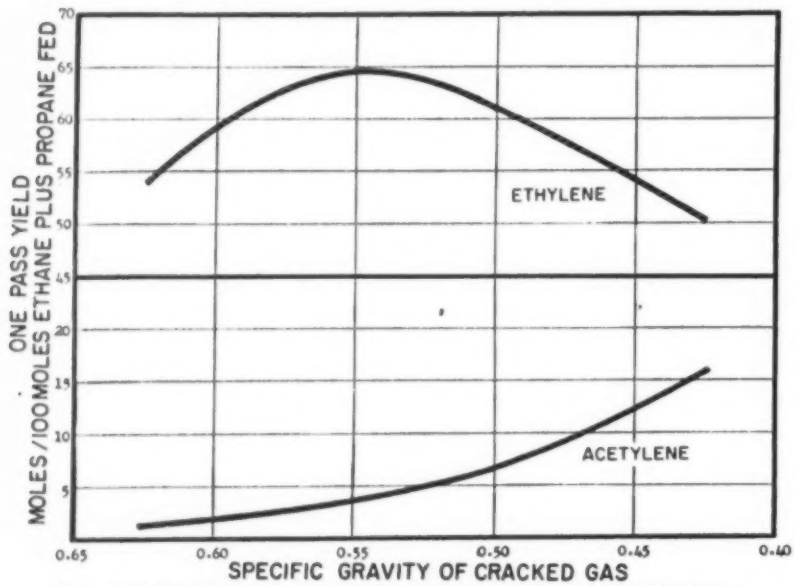


Figure 4. Yields of products from cracking an ethane-propane mixture pebble heater.

Yields Table 1 lists typical operating conditions for cracking n-butane in the pebble heater. The low operating pressure, short contact time, and high cracking temperature are significant factors in the high yields obtained.

Table 2 shows the feed and effluent analyses for a n-butane conversion of 91 percent. The ethylene and propylene contents of the reactor effluent were 37.3 and 6.7 mole percent, respectively. One-pass yields (pounds per 100 pounds n-butane feed) were 44.1 pounds of ethylene and 12.5 pounds of propylene. Under the conditions cited in Tables 1 and 2 for n-butane cracking, the 30Mm Btu Borger Pebble Heater will produce 74,000 pounds per day of ethylene and 21,000 pounds per day of propylene.

Figure 2 is a plot of ethylene and propylene one-pass yields from

n-butane cracking. This plot shows that the peak ethylene yield occurs at about 0.7 specific gravity (96 percent conversion). However, an increased quantity of oils and tars is also produced at this cracking severity, and operation is improved by controlling cracking depth to give a cracked gas specific gravity in the range of 0.75 to 0.78 (91 to 92 percent conversion). This is accomplished without appreciable loss in one-pass ethylene yield and with some gain in cracking efficiency or ultimate yield.

Figure 3 shows a comparison of pebble heater and tube furnace one-pass yields of ethylene and propylene from n-butane cracking. At 92 percent n-butane conversion the ethylene one-pass yield from the pebble heater is 63 percent greater than the tube furnace ethylene yield. At this same conversion the propylene yield is 46 percent less from the pebble heater than from the tube furnace. The combined ethylene plus propylene yield is 15 percent greater for the pebble heater than for the tube furnace. It is significant to note that the pebble heater at 92 percent conversion yields 50 percent more ethylene than does the tube furnace at 96 percent conversion.

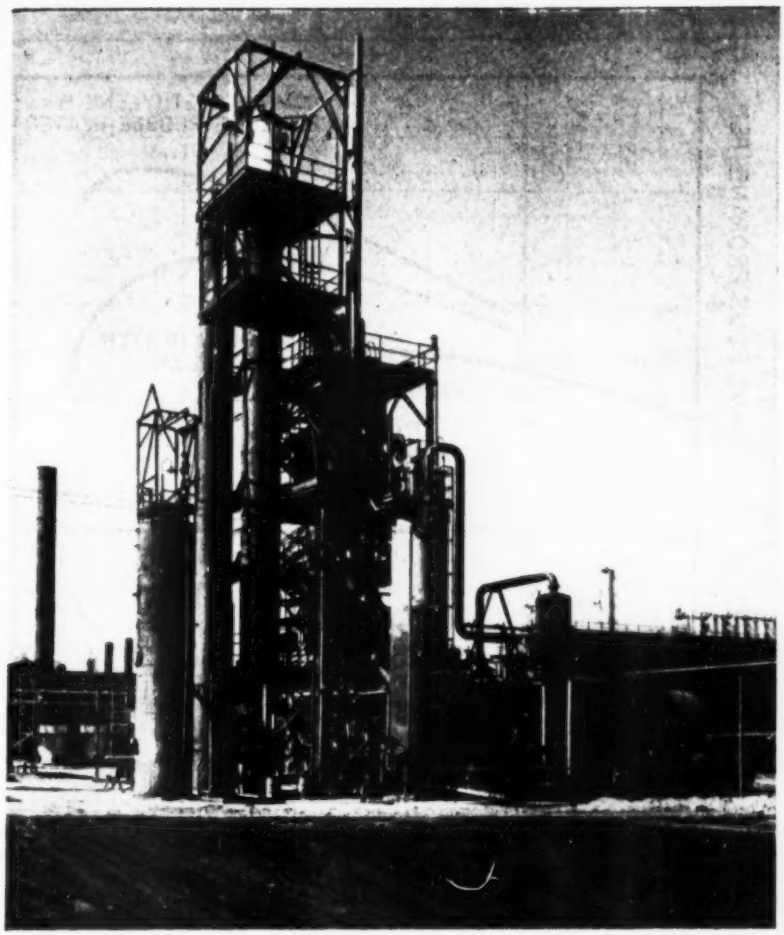
TABLE 1
Typical Pebble Heater Operating Data for N-Butane Cracking

PRESSURE, PSIG.	
Combustion chamber	3.4
Reactor feed inlet	5.2
Reactor outlet	3.3
TEMPERATURES, F	
Combustion chamber	2300
Reactor effluent	1625
Pebbles to reactor	1730
Pebbles from reactor	950
Air to air lift	950
PERCENT QUANTITIES	
Hydrocarbon feed (95% n-butane)	34,600 gpd
Combustion air	560,000 scfh
Combustion fuel (1000 Btu)	30,000 scfh
Cooling water	19Mm Btu hr
Electric power	530 kwh day
Steam, 250 psig	440 M lb day
Instrument air, 60 psig	25 cfm
Pebble make-up	150 lb day

TABLE 2
Pebble Heater Cracking Data for N-Butane

COMPONENT	Feed, Mole Percent	Effluent, Mole Percent
Hydrogen		16.6
Methane		30.5
Acetylene		1.2
Ethylene		37.3
Ethane		2.0
Propylene		6.7
Propane	0.3	0.1
Butadiene		0.6
Butenes		0.5
Isobutane	4.7	0.3
N-Butane	94.6	3.5
Other	0.4	0.7
	100.0	100.0
N Butane Conversion, Percent		91.0

	One-pass Yield lbs. 100 lbs. n-butane fed	Ultimate Yield lbs. 100 lbs. n-butane converted
Ethylene	44.1	48.4
Propylene	12.5	13.7



Pebble heater consists of two refractory-lined vessels positioned one above the other and connected by a refractory-lined seven-inch duct or throat.

Table 3, listing the feed and effluent analyses for two cases, shows the effect of ethane conversion level on product distribution. Case I data are for maximum ethylene yield which occurs near 90 percent conversion of ethane plus propane. Case II data show that an increase in conversion to 96.8 percent lowers the ethylene yield and increases the yield of acetylene. Although the ethylene one-pass yield is reduced from 64.3 to 53.4 moles per 100 mols of ethane plus propane in the feed while the acetylene yield is increased from 5.8 to 14.5, there is only a small decrease in combined yield of ethylene plus acetylene. The 30 Mm Btu unit at Borger will produce, in the first case, 56,500 pounds per day of ethylene and 4600 pounds per day of acetylene. In the second case the production is 46,300 pounds of ethylene and 11,300 pounds per day of acetylene.

Figure 4 is a plot of ethylene and acetylene one-pass yields from cracking an ethane-propane mixture. After passing its peak, the ethylene yield decreases and the acetylene yield increases. The sharpness of the peak is caused in part by the relatively large amount of methane in the feed which tends to hold the effluent gravity at 0.55. If methane were not present the curve would be considerably flattened.

Figure 5 shows a comparison of pebble heater and tube furnace one-pass yields of ethylene and acetylene from ethane-propane cracking. Both units were cracking essentially the same feed. Maximum conversion of ethane plus propane attained in the tube furnace was held to 70 percent because of metal temperature limitations. This corresponded to an ethane conversion of 75 percent. At this conversion ethylene one-pass yield was 56 moles per 100 mols of ethane plus propane in the feed, while the acetylene yield was essentially zero. The temperature limitations imposed upon

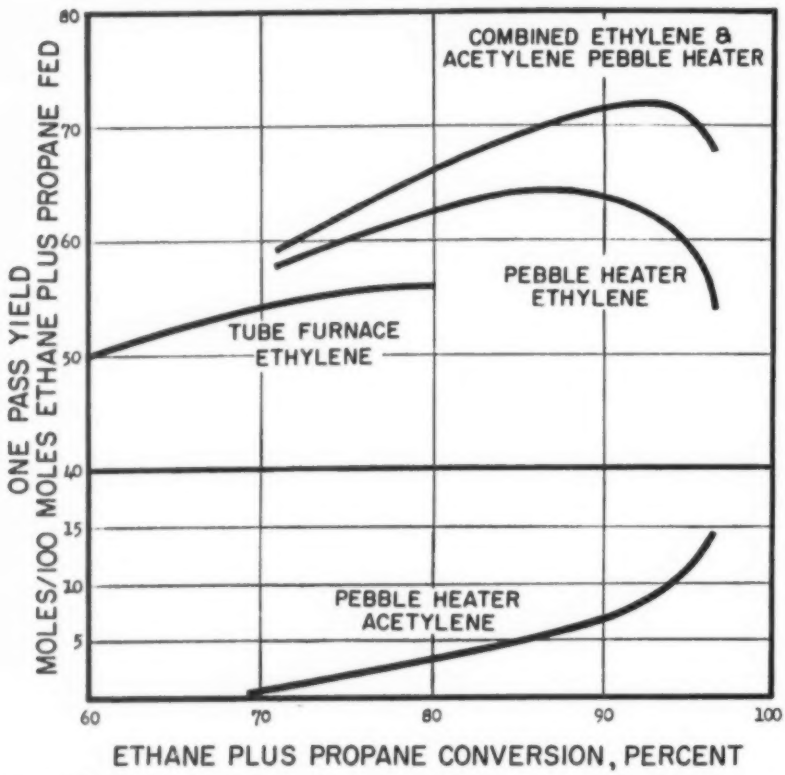


Figure 5. Yields of products from tube furnace and pebble heater cracking of an ethane-propane mixture.

TABLE 3

Pebble Heater Cracking Data From Ethane-Propane Mixtures

	CASE I For Maximum Ethylene		CASE II For Ethylene Plus Acetylene	
COMPONENT	Feed, Mole Percent	Effluent, Mole Percent	Feed, Mole Percent	Effluent, Mole Percent
Hydrogen		34.9		43.8
Carbon Monoxide		1.0		1.2
Carbon Dioxide	0.1	0.3	0.1	0.3
Methane	34.9	29.8	32.2	25.8
Acetylene		2.3		5.4
Ethylene		25.3		20.1
Ethane	55.2	3.9	63.1	1.1
Propylene		0.5		0.3
Propane	9.8	0.1	4.6	0.1
Butadiene		0.5		0.4
Benzene		0.7		0.8
Toluene		0.2		0.2
Cyclopentadiene		0.1		0.1
Hvy. Acetylenes		0.4		0.4
	100.0	100.0	100.0	100.0
Conversion				
Ethane		88.3		96.8
Ethane plus Propane		90.0		96.8
One-pass Yield (Mole 100 moles ethane plus propane fed)				
Ethylene		64.3		53.4
Acetylene		5.8		14.5
Ultimate Yield (Moles 100 moles ethane plus propane converted)				
Ethylene		71.6		55.2
Acetylene		6.5		15.0

the tube furnace do not apply to the pebble heater. For this reason the pebble heater can obtain ethane conversions as high as 97 percent. At this high conversion a considerable amount of acetylene is produced. At the maximum ethylene yield point (83 percent conversion) cracking an ethane-propane mixture, the pebble heater produces 15 percent more ethylene than does the tube furnace. However, a better comparison would include the acetylene. Such a comparison at the 83 percent conversion level shows that the pebble heater produces 25 percent more ethylene plus acetylene than the tube furnace. A still greater amount of ethylene plus acetylene is produced by the pebble heater at the peak of its combined yield curve at 93 percent ethane plus propane conversion. It is of interest to note that even at 97 percent conversion the cracking efficiency or ultimate yield of the pebble heater is equal to that of the tube furnace cracking at 75 percent ethane conversion (80 percent ethane plus propane conversion). At high conversion levels, ethylene recovery and purification equipment is simpler and smaller and recycle ethane is considerably reduced or entirely eliminated.

Operation—Although the design of the pebble heater is unique, it employs conventional equipment and is easily operated. One operator can readily handle two or three such units.

One of the major problems in pebble heater development was the reduction of carbon deposition in the reactor. Careful design has alleviated this problem but periodic burnouts of short duration are occasionally required. As more operating and design experience is gained, it is expected that burnout frequency can be further reduced or entirely eliminated.

Early operation of the pebble heater was severely handicapped by high pebble consumption caused by both abrasion and breakage. This is no longer a problem. At the present time pebble consumption for a 30-Mm-Btu unit in hydrocarbon service is about 150 pounds per day.

Mechanical maintenance costs are low. Although the unit uses blowers and turbines, modern equipment of this type requires little attention. Refractory life is good. The last turnaround followed nearly one year of operation, at which time the refractories were in excellent condition and appeared to have several years of life remaining.

Summary—In the field of light hydrocarbon cracking, the pebble heater has considerable process advantage in higher yields and higher conversions. Investment for a pebble heater will be slightly more than for a tube furnace for hydrocarbon cracking. However, economic evaluations of the cracking and recovery steps as a whole should show considerable advantage for the pebble heater.

The pebble heater has uses other than hydrocarbon cracking with which the tube furnace cannot compete. These uses include the heating of corrosive materials as well as the superheating of steam, air, or inert gases to very high temperatures. In these fields of operation, the investment costs for a pebble heater would be less than for hydrocarbon service.

The Phillips Pebble heater is a valuable contribution to the ever-widening field of high temperature processing equipment from which the design engineer may fulfill the particular needs of his company.

Phillips Pebble Heater is licensed by the Perco Division of Phillips Petroleum Company, Bartlesville, Okla.

Original presentation of this discussion was before the annual meeting of Western Petroleum Refiners Association, San Antonio, March, 1954.

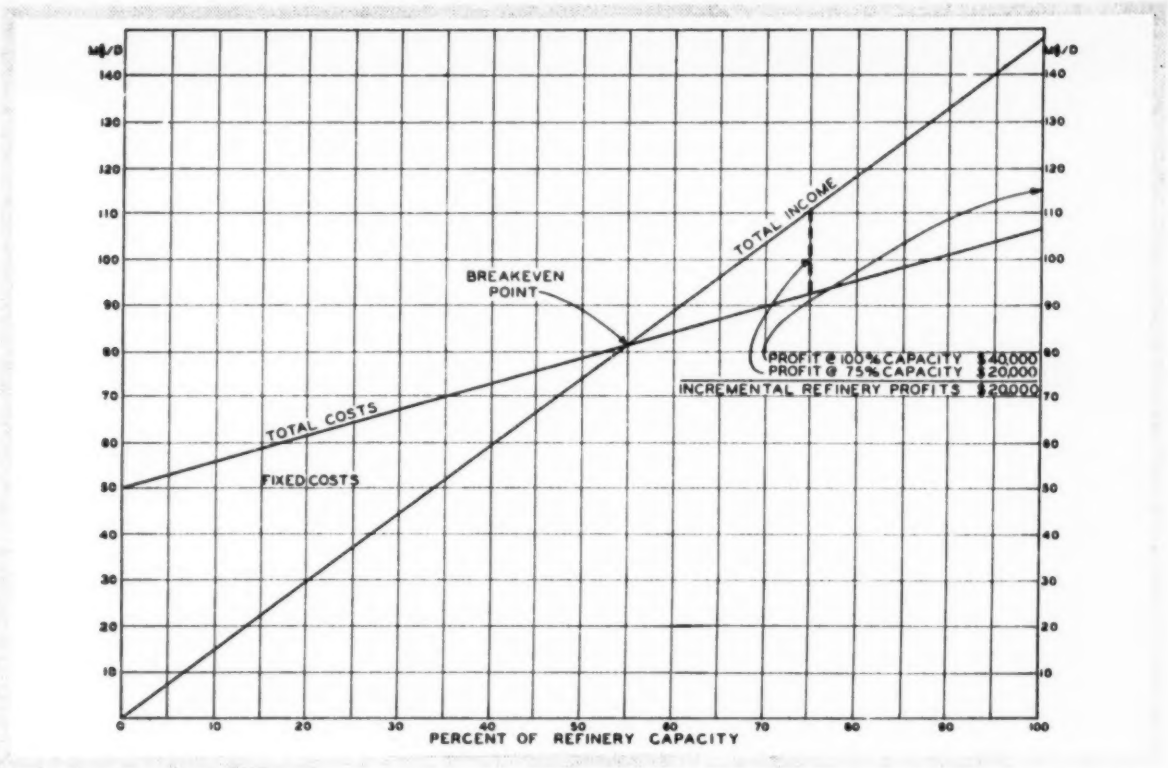


Figure 1. Typical profit picture for 40,000-barrel-daily refinery (with coking) showing incremental profits from sale of coke to acetylene plant.

Increase profits with . . .

Petrochemicals from Refinery Coke

- Increased profits from coking
- Advantages of coke-derived acetylene
- Conversion of coke to acetylene
- Petrochemical products from acetylene

E. L. Jones and F. D. Parker, Blaw-Knox Company, Tulsa
W. B. Strobel, Continental Oil Company, Houston

A PROFITABLE WAY for the refiner to dispose of fuel oil has been to install a coking unit to convert the fuel oil to catalytic cracking stock and coke. The coking unit serves two purposes:

1. To increase the value of the products made from each barrel of crude.
2. To remove the limitation on crude runs imposed by unsaleable fuel oil.

The profits to the refinery may be compounded by additional facilities to convert the coke into petrochemicals. The most versatile petrochemical, acetylene, can be made from coke by converting it to calcium carbide which yields acetylene upon hydrolysis.

The sale of refinery coke for the manufacture of acetylene accomplishes two things:

1. It assures the refiner of a steady market for his coke at a good price, which permits increased refinery profits for the two reasons stated previously, and
2. It permits additional profits from petrochemicals from the most flexible building block in chemistry—acetylene.

Increased Refinery Profits from Coking—Figure 1 is a typical profit picture for a 40,000-barrel-per-day refinery. The crude runs may be limited to 75 percent of capacity by a restricted market for fuel oil. The installation of a coking unit permits crude runs at 100 percent capacity, which increases the profits. The difference between total income and total costs represents *profit* or *loss*. The break-even point in this case is about 55 percent of full capacity. The gross profit before taxes at 75 percent of capacity is $20,000 per day.

The installation of a coking unit permits operation at full refinery capacity, or at gross profit of $40,000 per day.

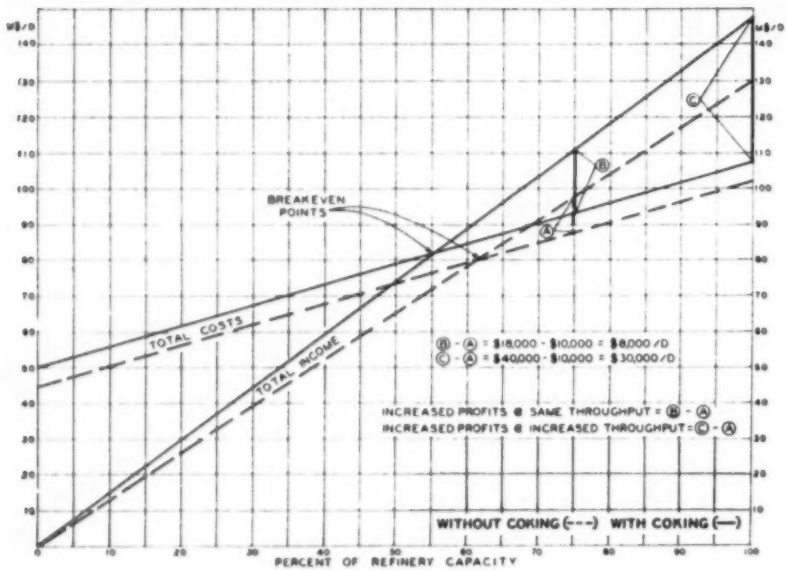

M$/D
BREAK EVEN POINTS
TOTAL COSTS
TOTAL INCOME
Ⓑ - Ⓐ = $18,000 - $10,000 = $8,000 /D
Ⓒ - Ⓐ = $40,000 - $10,000 = $30,000 /D
INCREASED PROFITS @ SAME THROUGHPUT = Ⓑ - Ⓐ
INCREASED PROFITS @ INCREASED THROUGHPUT = Ⓒ - Ⓐ
WITHOUT COKING (---) WITH COKING (—)
PERCENT OF REFINERY CAPACITY

Figure 2. Typical profit picture for a refinery: with and without coking.

The profit from the incremental crude capacity is $20,000 per day. Of course, this analysis assumes that there is an adequate market for the extra LPG, gasoline, and coke produced. The petroleum coke market can be assisted by converting coke to calcium carbide and manufacturing acetylene or other chemicals from that. The profit shown above is profit from operation of the refinery alone and does not include any petrochemical profits.

Another picture perhaps more in tune with present times when the object may not be to run more crude but to increase the value of the refined products, is presented in Figure 2. The dotted lines represent a profit picture for a refinery which has no coking unit and which is limited by the fuel oil market to 75 percent of capacity. The profits in this situation amount to $10,000 per day. The break-even point is 61 percent. By the installation of a unit to make coke, the total costs are more but the total income is also more since the products are upgraded in value. At the same crude throughput of 75 percent of capacity, the profits have been increased to $18,000 per day or a profit increment of $8000 per day. The break-even point has been lowered to 55 percent of capacity. However, if greater product values and greater crude runs are both desired, the refinery at 100 percent of capacity will yield a profit of $40,000 per day or an incremental profit of $30,000 per day over the previous picture before the coking unit was operating. From these analyses, it may be shown that the refinery can profit greatly from a coking unit providing it can be assured of a steady market for the coke.

There are several ways in which a refinery may profitably dispose of coke, and the chief way, besides fuel, has been to sell the coke to the aluminum industry for electrodes. A one-step process for converting fuel oil as such to electrode coke of a specific gravity of 2.0 consists of coking the fuel oil on a heated refractory slab in a broad oven. A typical block flow diagram for this operation is shown in Figure 3. It will be noted that coke fines may also be charged with fuel oil to produce lump coke of metallurgical quality. This feature is an additional attraction for the refiner who already has a coking unit with hydraulic decoking equipment which produces roughly 50 percent of the coke as fines, which are not readily useable for things other than fuel. The calcining step here represented enables the value of the coke to be upgraded from $10 to $25 per ton at present prices.

It is appropriate to point out at this point that the several coking processes which have been installed all produce coke which may be calcined to make coke of electrode grade.

Conventional delayed coking, contact coking, fluid coking and decarbonizing unit all make coke which is higher in volatile matter than can be tolerated for electrodes and calcining removes this volatile matter. Of these processes, mechanical decoking combined with decarbonizing produces lump coke which may be calcined directly without the need for careful agglomeration of fines required by processes which deliver small particles of coke. Furthermore, for special situations, the decarbonizing units can be operated at conditions which will produce reasonably controllable yields and properties (volatiles, moisture, etc.) of the coke from a given fuel oil. However, the concepts in this paper are applicable to any of these processes that the refiner might install, or be considering.

Supplementary processes such as the broad oven may be used to provide coke of suitable volatile matter or particle size for the electrode industry. However, another outlet exists for raw coke from the refinery without special equipment for calcining. Raw coke of suitable size may be charged to an electric furnace together with lime for the production of calcium carbide which, thereupon, changes the coke from an almost waste disposal product to a valuable petrochemical intermediate since the acetylene made from hydroly-

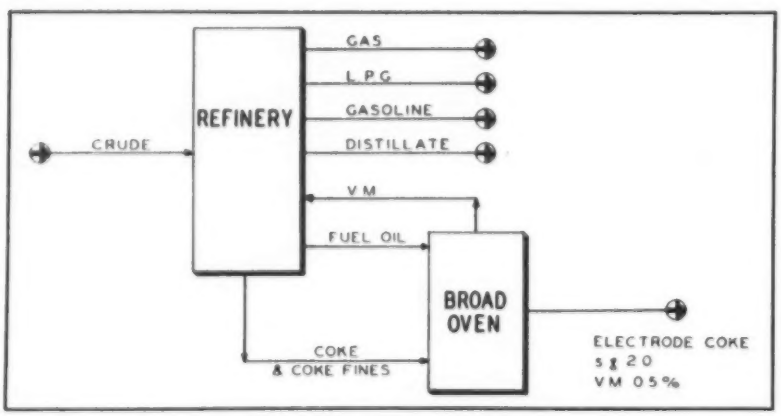


Figure 3. Block flow diagram for electrode coke.

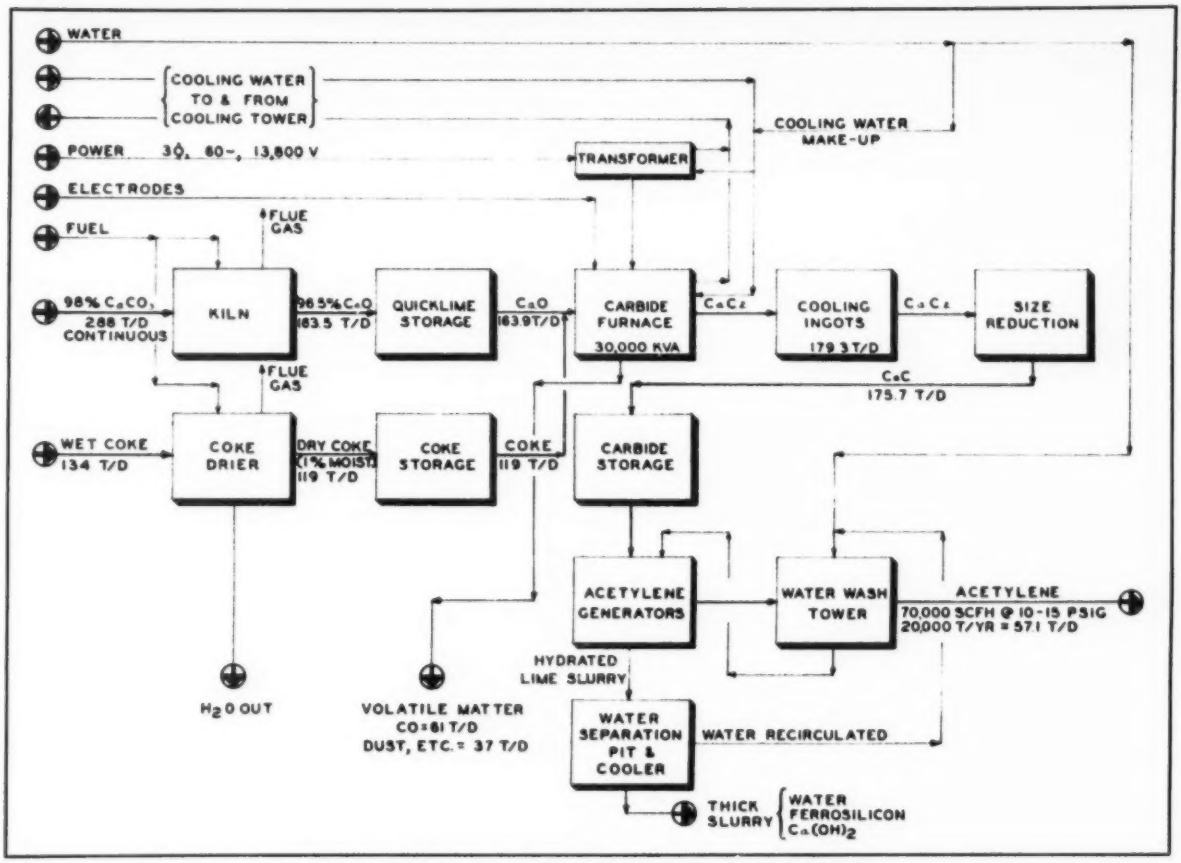


Figure 4. Block flow diagram for typical carbide and acetylene plant.

sis of the calcium carbide is a versatile chemical building block. The profits shown for a 10,000 barrel-per-day refinery apply on a lesser scale to a smaller refinery or the figures apply to a pool of refineries processing an aggregate of 10,000 barrels of crude per day. Greater profits are possible if a heavier crude may be substituted, since the total cost line is lowered and a greater coke yield obtained.

The Acetylene Process Description The process to make calcium carbide from coke is illustrated in Figure 1 as a block flow diagram. This plant is for 10,000,000 pounds per year of acetylene, and is not necessarily tied to a 10,000 barrel-per-day refinery, since a small refinery may run a heavy crude to a higher yield of coke, or several refiners may provide coke for a plant of this size. The size of the raw coke lumps should range from $\frac{1}{8}$ to 1 inch.

The preferred coking unit to provide a maximum of this type of raw coke is a drum coker or decarbonizing unit with mechanical removal of the coke from the drums.

The block flow diagram illustrates the complete process and outlines the individual steps required together with data on the material balance for a general situation. Coke from the coking unit is transported to the plant site in railroad cars, stored and screened. On the premise that wet coke is produced by hydraulic decoking, such coke contains approximately 12 percent moisture and is dried in the dryer using natural gas fuel to 1 percent moisture. Essentially dry coke can be produced directly from a decarbonizer equipped with mechanical decoking. The dry coke is stored before being mixed with quicklime by automatic weighing devices. The mixture of coke and quicklime is charged to the carbide furnaces where it is converted into calcium carbide, which contains impurities consisting of quicklime (about 15 percent), unconverted carbon, and traces of ferrosilicon, nitrogen, sulfur and phosphorous compounds. The molten calcium carbide at 4500 F. is tapped from the furnace and poured into ingots, which are allowed to cool in the atmosphere to about 600 F. These ingots are then crushed to a size suitable for charging to the acetylene generators. The ferrosilicon is removed from the crushed carbide by a magnetic separator and the carbide is stored in steel bins which are purged with dry inert gas.

Carbide furnaces require approximately 2900 kwh per ton of carbide and they also consume preformed electrodes at the rate of 50 pounds per ton of carbide. A transformer is required to reduce electric power to approximately 170 volts for the carbide furnaces. Cooling water is required for the transformer and the clamps of the electrodes and the closed tops of the furnaces. In the acetylene generator water is added to the carbide, raw acetylene is taken from the top of the generators, and a hydrated lime slurry is removed from the bottom of the generators.

The acetylene is purified by removing trace components of phosphorus, ammonia, arsine, and the lime by a sulfuric acid wash. Traces of acid and hydrogen sulfide are removed by a caustic wash. The pure acetylene is then piped to the consumer. Lime hydrate is continuously removed from the bottom of the generators as a dilute slurry with a calcium hydroxide content of approximately 10 percent.

Either limestone, purchased lime, or

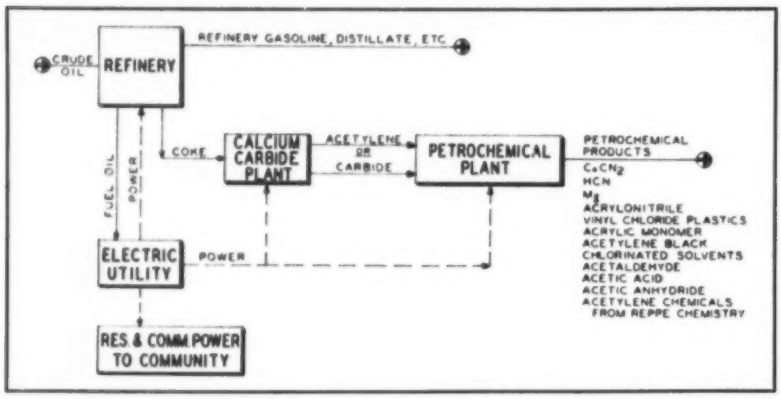


Figure 5. Fuel-power relationship between refinery, utility plant, carbide plant, and petrochemical plant.

recycled lime may be used with the coke in the carbide furnace. The kiln is fired with natural gas and carbon monoxide from the carbide furnaces. This carbon monoxide carries collected fines and volatile matter from the carbide furnaces.

Advantages of Making Acetylene from Coke—1. The acetylene made from calcium carbide compares favorably in cost with the acetylene made from hydrocarbons. The cost of electric power is the major cost in making acetylene from carbide. A lower cost of electric power may be achieved in any locality where power is purchased from a grid by operating the carbide furnace at 75 percent of capacity during peak periods and at 125 percent of capacity during the periods when off-peak power can be purchased more cheaply, usually at rates of ½ to 1 mil per kwh less than normal rates.

The cost of making acetylene by thermal cracking of hydrocarbons has been reported in recent literature. Acetylene made from calcium carbide using petroleum coke costs about the same and in addition, possesses certain other very important advantages. The cost figures are relative to any specific installation and naturally vary with the location. However, the figures for acetylene from calcium carbide are based on a conventional and commercially proven carbide operations and developments now in progress should reduce the costs still more.

2. In discussing the production of acetylene from hydrocarbons, natural gas is likely to be the most abundant feedstock and, therefore, the cheapest hydrocarbon available. A plant producing 40 million pounds per year of acetylene would require 2000 barrels per day of propane, if propane were used as feed. It follows that an acetylene plant using propane alone as feedstock would need to be located close to a very large refinery. Also, the amount of coke for feedstock in a typical refinery is likely to be several times the amount of propane.

3. Furthermore, raw coke is not likely to be subject to the price escalation which has occurred and is still occurring to natural gas and other hydrocarbons.

4. The calcium carbide process delivers pure acetylene with a minimum of other hydrocarbons which are also produced from other processes using hydrocarbon feeds. For example, in thermal acetylene process, off-gas and tars are produced which must be marketed. No such problem exists with acetylene from carbide, so the process economics do not hinge on additional and possibly fickle markets for these byproducts.

5. Processes for producing acetylene from hydrocarbons can not compete with the high purity acetylene available from calcium carbide, which is required for certain chemical syntheses. Acetylene from carbide can be readily produced at a purity of 99.5 percent—relatively simple refining steps can effect a higher purity.

6. The carbide furnace produces an off-gas containing carbon monoxide which can be purified to use in certain chemical syntheses instead of being used as fuel as shown on the block flow diagram.

$$CaO + 3C \rightarrow CaC_2 + CO.$$

This carbon monoxide can be used, for example, with the hydrogen from the refinery's catalytic reforming unit to provide synthesis gas for a variety of products, such as high melting point waxes (100 C. melting point).

7. It is not necessary to convert refinery coke to acetylene, but only to calcium carbide. The calcium carbide may be sold directly to chemical manufacturers or used for fertilizers, etc.

8. The easiest way to ship acetylene is in the solid form as calcium carbide. This way is also the cheapest except for pipelines which can only be used for very short distances. The major source of acetylene which is used for chemical manufacture is still carbide shipped by rail. By road, for short hauls, carbide may be moved in closed hoppers on trucks. A central generating plant supplied by trucks or by railroad cars may supply acetylene through a pipeline to several chemical plants. There is quite a contrast between this mobility for acetylene derived from calcium carbide with the acetylene derived from natural gas. Plants consuming acetylene made from natural gas must be located near the acetylene plant. Therefore, a refiner contemplating markets for carbide from refinery coke should not limit his thinking to the local industries.

9. Since the acetylene production is based on refinery coke as a raw material, in some cases the refinery may be able to show an additional profit by purchase and processing of a heavier crude.

Petrochemical Products from Refinery Coke—Briefly, the chemical possibilities of refinery coke converted in the electric furnace to calcium carbide indicate that additional processing can yield the following products:

1. **Calcium Cyanamid**—a fertilizer. Calcium carbide is heated with nitrogen in an electric furnace. The reaction is exothermic and almost self-sustaining once it has started.

$$CaC_2 + N_2 \rightarrow CaCN + C_2.$$

2. **Hydrogen Cyanide.** May be prepared from calcium cyanamid by first preparing sodium cyanide in an electric furnace.

$$CaCN_2 + C + NaCl \rightarrow CaCl_2 \rightarrow 2NaCN.$$

3. **Magnesium Metal.** By heating magnesium oxide at 1100 C. with calcium carbide, metallic magnesium of high purity (99.99 percent) was made during World War II.

$$MgO + CaC_2 \rightarrow Mg + CaO + 2C.$$

The use of magnesium has been predicted to grow many fold in the next few years.

4. **Acetylene.** Acetylene is the basic building block for a large number of useful chemical products which may be briefly outlined as follows:

a. *Acrylonitrile* for synthetic fibers, plastics, rubbers, and soil conditioners. Hydrogen cyanide is added to acetylene to give acrylonitrile. Both hydrogen cyanide and acetylene may be obtained from calcium carbide which in turn may be made from refinery coke. Acetylene made from carbide is of such high purity that it makes acrylonitrile which does not require the

complex purification of acrylonitrile made from hydrocarbon-source acetylene.

b. *Vinyl chloride plastics.* By the addition of hydrochloric acid, vinyl chloride may be produced from acetylene. Subsequent polymerization of the vinyl chloride yields a versatile plastic which is the workhorse of thermoplastics. Growth of vinyl chloride production has been phenomenal.

c. *Acrylic monomer* is being made directly from carbon monoxide and acetylene and an alcohol in Rohm & Haas Company's plant in Deer Park, near Houston. Both carbon monoxide and acetylene are available from the carbide route. This plant is an example of the economic advantages of carbide-derived acetylene over ethylene since it costs less to make acrylic monomer from acetylene.

d. *Acetylene black* may be made by partial oxidation of acetylene under closely controlled conditions. The black is sold for a premium price for batteries, etc.

e. *Chlorinated solvents* such as trichlorethylene may be made from acetylene.

f. *Acetaldehyde, acetic acid* and *acetic anhydride,* widely used chemical intermediates, are available from acetylene.

g. *Reppe Chemistry.* A very large segment of acetylene chemistry, which is mainly unexplored in a commercial manner, is the chemistry developed by Dr. Reppe in Germany during World War II. The manufacture of acrylic monomer from carbon monoxide and acetylene is an example of the commercial use of this Reppe chemistry. Other reactions are of an entirely new nature and yield such diverse products as rocket fuels, blood plasma substitutes, and the like.

Figure 5 illustrates some of the petrochemical products which may be made from refinery coke, as well as the fuel-power relationships between the refinery, the acetylene plant, and adjacent petrochemical plant or plants.

This short dissertation on the value of refinery coke as a petrochemical intermediate and the profits available to the refiner and an adjacent petrochemical plant does not include the other benefits which accrue to the community when public utilities also cooperate. A public utility which provides a low industrial power rate benefits from the extra domestic power used by the families of people required to operate the petrochemical plant or plants, and the related service industries (stores, laundries, etc.). Since acetylene is such a versatile petrochemical, the growth of the community, the public utility, and the refinery are assured with the use of the additional acetylene by new and different petrochemical plants.

For every unit of additional industrial power supplied by an electric utility to a petrochemical project of this type, it is estimated that a unit of residential and commercial power is also required, at a rate double that of the industrial power. Thus the electric utility supplying the power stands to benefit in two ways, with the revenue from the industrial installation only one-third of the total.

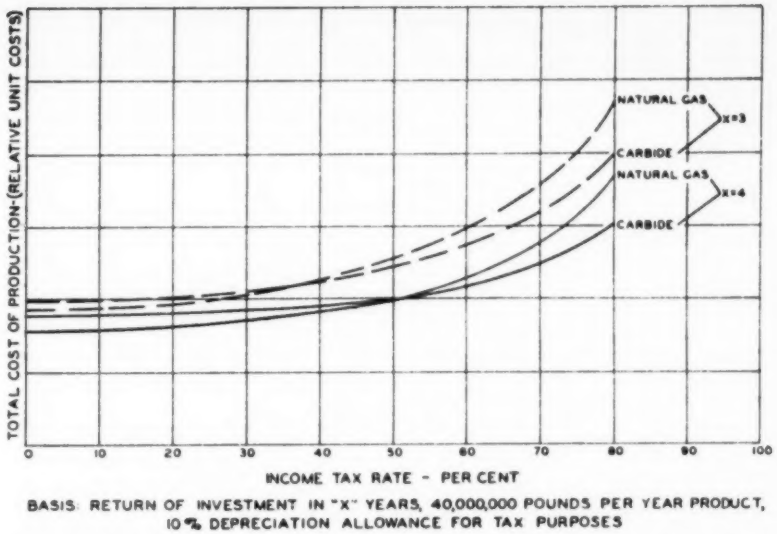


Figure 6. Effect of income tax rate on relative costs for producing acetylene from carbide and natural gas processes.

Figure 5 shows the fuel-power exchange which can be of such benefit to the community. This type of cooperation has been effected in various localities. These general community benefits, coupled with the specific profitability to the refiner, underline the present and growing importance of petroleum coke as a valuable petrochemical intermediate.

One additional point may be made regarding the relative costs of manufacturing acetylene under the existing tax laws, and disregarding any proposed changes in them. The tax rate very definitely influences the selling price of the acetylene which must be expected in order for the plant to return the investment before obsolescence of the plant. The relative magnitudes of the investment and the operating costs also influence the price which must be expected. The relationship of these factors is shown in Figure 6 comparing carbide acetylene with acetylene derived from hydrocarbons by processes recently reported in the literature.[1]

The investment required for a plant to manufacture 40 million pounds per year of acetylene from calcium carbide made from petroleum coke is about two-thirds of the investment for a plant to make acetylene from natural gas. The carbide plant is based on proven plant construction and operation, whereas, thermal cracking of natural gas is based on engineering estimates not yet confirmed by actual installations. The present corporate tax picture is such that a smaller investment with higher operating costs, as is the case of the carbide plant, will pay out faster after taxes than a plant with a larger investment and smaller operating expenses, such as, a plant making acetylene from natural gas.

Figure 6 shows the effect of tax rates upon the relative costs of producing acetylene from natural gas and from carbide made from refinery coke. These costs are relative and not absolute, as the economic picture varies for each location, but the same utility costs were used for this comparison. For a return of investment in four years, corporations with an income tax rate above 50 percent would find carbide acetylene to have the lower cost, and the same relation exists for a three-year return for corporations with a tax rate greater than 35 percent.

Conclusion Refinery coke may be considered as a valuable material which may be used as an intermediate for the manufacture of valuable petrochemicals. These petrochemicals are the types for which markets have been expanding rapidly in recent years. The refiner, alone or in conjunction with chemical companies, can profit from this situation in the manner shown with a proven process for manufacturing acetylene of high purity from the large quantities of petroleum coke available.

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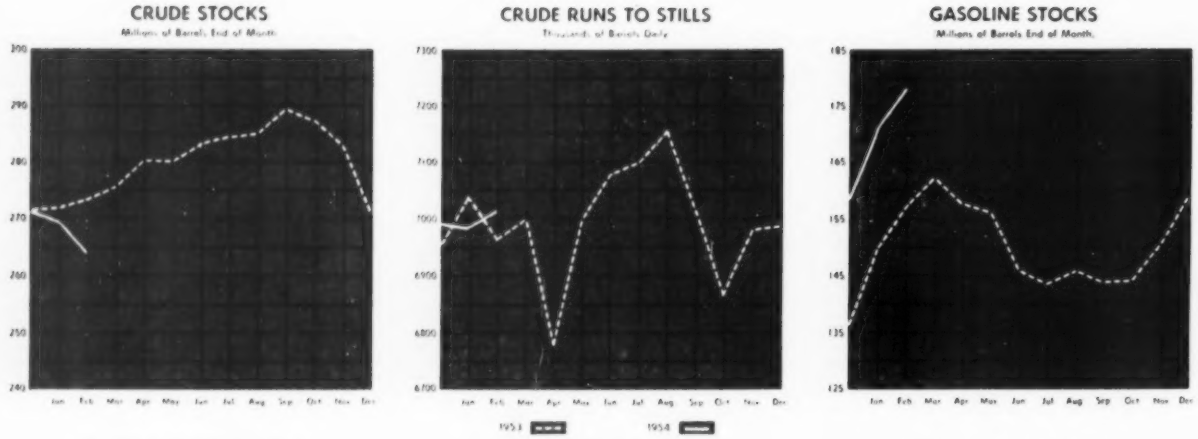
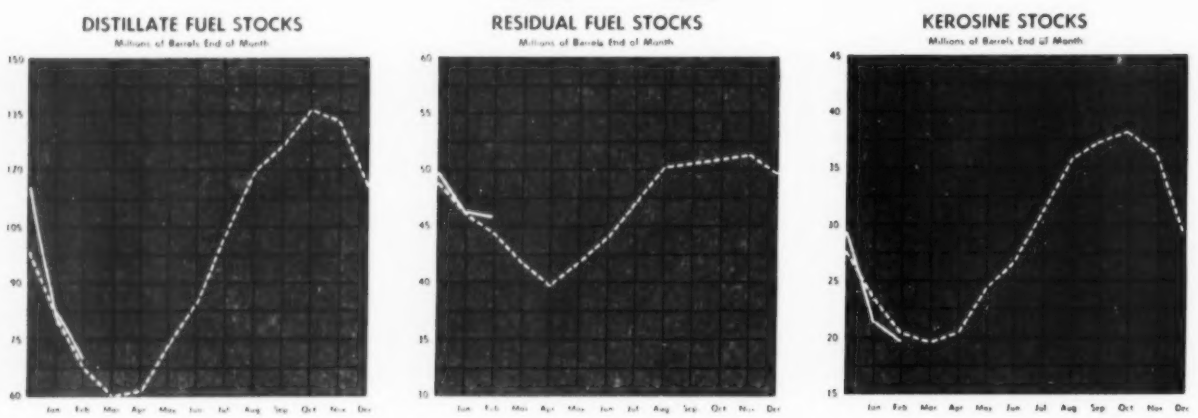



DISTILLATE FUEL STOCKS
Millions of Barrels End of Month
RESIDUAL FUEL STOCKS
Millions of Barrels End of Month
KEROSINE STOCKS
Millions of Barrels End of Month

Taking Stock

Cecil W. Smith
Economics Editor

(DATA IN THOUSANDS OF BARRELS)

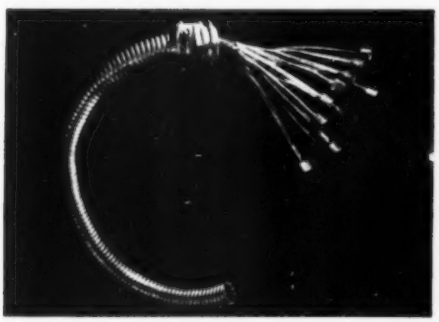
MONTH	CRUDE OIL			GASOLINE		KEROSINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1952:													
July	6,083	6,927	275,951	3,295	116,566	358	27,387	1,475	85,775	1,237	52,215	597	892
August	6,219	7,118	264,368	3,377	118,502	375	32,401	1,514	104,237	1,252	54,061	632	879
September	6,518	7,017	264,723	3,428	120,991	350	35,021	1,502	117,272	1,240	56,200	615	902
October	6,518	6,883	269,776	3,301	120,062	372	33,289	1,458	120,721	1,200	53,032	643	1,038
November	6,487	7,049	267,852	3,476	129,509	393	32,199	1,510	116,096	1,269	53,089	624	984
December	6,634	6,952	271,928	3,361	136,028	421	26,842	1,509	99,582	1,302	48,706	603	1,165
1953:													
January	6,655	7,042	272,250	3,384	150,518	433	23,202	1,528	80,655	1,307	45,910	616	1,135
February	6,562	6,960	273,589	3,379	157,873	404	20,468	1,505	67,167	1,275	44,178	586	1,066
March	6,731	7,002	275,665	3,319	162,731	359	18,697	1,489	59,802	1,256	41,609	655	1,112
April	6,446	6,781	280,487	3,282	158,032	361	20,335	1,474	61,349	1,219	39,572	628	1,070
May	6,390	7,002	280,308	3,366	156,415	327	24,307	1,400	73,706	1,197	41,795	703	1,096
June	6,595	7,081	283,715	3,467	146,196	376	27,679	1,462	84,504	1,238	43,801	707	1,070
July	6,603	7,103	284,976	3,583	143,916	391	31,143	1,441	102,258	1,224	47,739	629	950
August	6,583	7,163	285,352	3,592	146,070	421	35,711	1,437	119,542	1,222	50,067	672	946
September	6,557	7,023	280,614	3,521	144,184	330	37,280	1,448	126,709	1,203	50,516	692	1,013
October	6,262	6,872	287,541	3,437	144,195	355	38,161	1,462	135,409	1,184	50,820	639	960
November	6,277	6,987	283,021	3,528	150,747	354	36,271	1,463	133,381	1,223	51,267	618	1,120
December	6,238	6,964	276,676	3,628	156,949	378	29,070	1,441	111,944	1,247	49,370	508	1,121
1954:													
January	6,282	6,985	269,929	3,466	171,750	400	21,294	1,487	79,249	1,222	45,963	642	1,123
February	6,311	7,016	263,929	3,493	174,175	419	19,263	1,550	69,032	1,232	45,959	643	1,158
Feb., 1954 Change:													
In Month	+28	+31	6,000	+27	+2,425	+19	1,611	+63	10,217	+10	-4	+1	+35
In Year	-252	+47	9,660	+114	+21,302	+15	905	+45	+1,835	-43	+1,781	+57	+92
Week Ended:													
3/20/54	6,461	7,013	263,808	3,351	179,399	338	18,050	1,537	63,331	1,209	44,507	627	1,114
3/27/54	6,489	7,099	274,480	3,322	183,324	404	18,192	1,477	59,451	1,278	44,841	614	1,102

Source: Data for last two months from API; prior monthly data from Bureau of Mines.

For the new pneumatic instrumentation

Cabled Tube

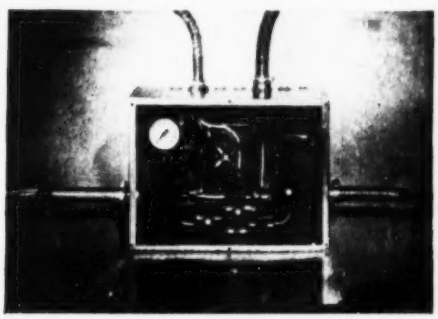
The recent tremendous increase in the use of tube instead of wires for instrumentation and control purposes has led to an important new development—cabled tube. This is an armored group of long tubes twisted together to permit bending without distortion. An insulating tape is wrapped over the bundle of tubes to prevent electrolytic action. Then interlocking, flexible galvanized steel armor is applied, like BX. This protects the tubes from injury during shipment, storage, installation, and in service. Standard fittings, boxes and cabinets can be used for junction boxes and terminations. To make it possible to readily identify each tube, one tube in each layer is colored; the position of each tube in each layer in relation to the coded tube



remains the same throughout the length of the cable.

The tubes usually are copper, but aluminum tubes can be used for special purposes. For unusually corrosive situations, a plastic outer sheath can be applied. As many as 19 tubes, ¼" OD, can be cabled, and supplied in lengths up to 1,000 ft.

Since the tubes carry not electricity but air, nitrogen, helium, or a fluid, they are especially attractive in potentially explosive locations, as in refineries and chemical plants. Utilities are also turning decisively to this new cable, while automatic process control (automation) is a rising application.



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Meet Our Authors . . .

E. G. Ragatz | W. H. Kehoe | L. C. Harbert | S. T. Preston | W. J. Podbielniak | F. Zapffe

Ragatz Made Specialty in Natural Gasoline Field

Edw. G. Ragatz, "Low-Temperature Process Advances," page 115.

Edward G. Ragatz, graduate of Massachusetts Institute of Technology, has made a specialty of absorption and distillation operation associated with the natural gasoline industry. As head of Edw. G. Ragatz Company, he has been closely associated with his "first love"—the natural gasoline field—doing consulting work and design and construction of natural gasoline equipment, and gasoline plant surveys.

Kehoe Points Out Orifice Meter Errors

W. R. Kehoe, "Orifice Meter Errors," page 118.

Since joining American Meter Company in its offices in Erie, Pa., in 1946, W. R. Kehoe has been associated with research, engineering and sales. Previously he had spent ten years in the instrument department of Humble Oil & Refining Company's Baytown, Texas, refinery.

Vaughan Knows Much Of Gasoline Plants

Harold E. Vaughan, "Do Gasoline Plants Pay Out?" page 112.

At one time or another Harold E. Vaughan, regional chemical engineer, natural gasoline and gas operations at Continental Oil Company, has held practically every type of gasoline plant assignment. From the time he joined Conoco in 1939 until he entered the U. S. Armed Forces in 1942, he was assigned to a gasoline plant as fireman, operator, separatorman, meterman, tester, design and construction engineer. Returning to the company upon his discharge in 1946 he was successively tester-maintenance man; process foreman—gasoline plant; engineer—natural gasoline and gas, headquarters staff; and chemical engineer—natural gasoline and gas, executive headquarters staff. He was assigned to his present post in 1951.

Preston and Podbielniak Give and Take Assistance

S. T. Preston and W. J. Podbielniak, "Low Temperature Distillation," page 132.

S. T. Preston is assistant to the president of Podbielniak, Inc., of Chicago; that president is W. J. Podbielniak. So in the preparation of this article, the "assistance" becomes a two-way street.

Before joining Podbielniak, Preston was an instructor of the Natural Gasoline Association of America's Low Temperature Fractional Analysis School. He holds a B.S. degree in chemical engineering from Virginia Polytechnic Institute and an M.S. degree from the University of Michigan.

A man of impulse, drive and multiple talents is W. J. Podbielniak. He has been an instructor in chemistry, physics, mathematics and, according to his wife, piano. For his work in the natural gasoline field, NGAA in 1951 awarded him the Hanlon Award, highest honor in the natural gasoline industry.

Zapffe Expecting Addition Momentarily

F. Zapffe, "Natural Gas Correlations," page 142.

If everything goes according to schedule, at just about the same time F. Zapffe's article is published in this issue, Zapffe and his wife will be doing some publishing of their own: it will be their second addition, to go with their first, a boy.

Zapffe is research engineer at Lone Star Gas Company, in charge of the group responsible for compressor station, dehydration plant and desulfurization plant design. He started with Lone Star Gas in 1939, immediately after receiving a B.S. in chemical engineering from Texas Technological College. He was plant chemist before going into the U. S. Army Air Corps. He returned to the company after his discharge and became research engineer in 1952.

Harbert Made His Career Out of Early Partnership

Lloyd C. Harbert, "Vapor Phase Engine Cooling," page 127.

Three engineers got together in 1931 and formed a partnership as engineering contractors, and as such they designed and installed gas engine power plants. One of those engineers was Lloyd C. Harbert; today he's president of that now incorporated company, Engineering Controls, Inc.

Educated in public schools and by extension courses, Harbert got his early experience at Cosden Oil & Gas Company and Oklahoma Natural Gasoline Company.

A. L. Conn | J. H. Forrester | J. B. Malloy | E. L. Jones | W. B. Strobel | F. D. Parker

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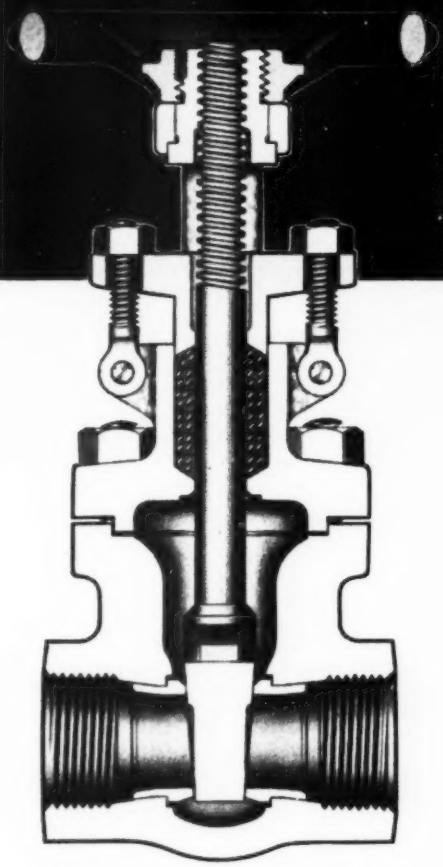
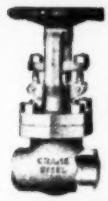


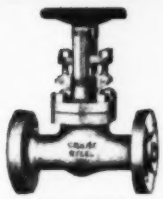
BOLTED BONNET OR UNION BONNET

In the cross-section of the bolted bonnet pattern above, you can see the rugged *big-valve* construction. Bolted bonnet valves available in sizes ½ to 2-inch—union bonnet valves in sizes ¼ to 2-inch.



Screwed Ends—Union Bonnet or Bolted Bonnet

Socket-Welding Ends—Bolted Bonnet or Union Bonnet



Flanged Ends—Bolted Bonnet only

Look no further for dependable steel valves in sizes up to 2-inch. Whether you prefer the union bonnet or bolted bonnet pattern, you get refinements usually found only in larger, more expensive valves.

For example, you get a compact, weight-saving structure of high-quality carbon steel. Smooth operation and positive closure of the solid wedge disc are assured by a T-head disc-stem connection and full-length machined guide ribs. There's also an unusually large stuffing box filled with high-grade packing, a leakproof bonnet joint with retained gasket, a husky stem with outside threads, and many others. To simplify maintenance, Crane design includes swinging gland eye-bolts—plus a wide yoke with liberal working space around the gland.

USER'S CHOICE OF TRIM

There's versatility to these quality Crane steel valves, too. You can have your choice of trim to suit your service—Class X Trim (Exelloy body and body seat rings) for oil or oil vapor—Class XW Trim (Exelloy seat rings, disc of hardened stainless steel) for steam or water. Union bonnet valves also available with Class L Trim (18-8 Mo Alloy seats, disc, stem) for liquids and gases up to 750° F.

Full details in 6-page folder AD-1881. Ask your Crane Representative next time he calls, or write direct.

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V. A. Kalichevsky C. A. Duval H. W. Grote C. H. Watkins F. R. Weise I. Ladimer

M.I.T. Alumni Have Scoop on New Process

Jay H. Forrester, A. L. Conn and J. B. Malloy, "Ultraforming, New Reforming Process," page 153.

If you want to know something about Ultraforming, this threesome from Standard Oil Company (Indiana) can readily fill you in. Jay H. Forrester is manager of research for Standard, A. L. Conn is director of the Pilot Plant division in the Research department and J. B. Malloy is a chemical engineer in the Pilot Plant division.

Born at Hillsboro, Texas, Forrester was graduated from the University of Wisconsin in 1928 with a B.S. degree, and from Massachusetts Institute of Technology in 1932 with an M.S. degree in chemical engineering. He has been with Standard since 1929 except for a six-year period during which he was assigned to Standard Oil and Gas Company.

Conn, a New Yorker, has been with Standard since 1939. He received B.S. and M.S. degrees from M.I.T., the latter coming in 1935. After serving as an assistant director in M.I.T.'s School of Chemical Engineering Practice, he was associated with Blaw-Knox Company and later with Alco Products division of American Locomotive Company before joining Standard.

Malloy also is an M.I.T. alumnus, having received B.S. and M.S. degrees there in 1950 and 1951, respectively. He was born in Chicago and has been with Standard since 1951.

Jones, Strobel, Parker— News From Two Views

E. L. Jones, W. B. Strobel and F. D. Parker, "Petrochemicals From Refinery Coke," page 175.

Representing the engineering viewpoint in this matter of getting petrochemical profits from refinery coke are E. L. Jones and F. D. Parker, both of Blaw-Knox Company's Chemical Plants Division. Representing the operating viewpoint is W. B. Strobel, of Continental Oil Company. These two viewpoints, backed up by a wealth of experience, have resulted in a well presented article.

A native of Prince George, British Columbia, Canada, Jones worked his way through McGill University, graduating in 1941 with a degree in chemical engineering. His experience in process and project engineering was gained at several engineering contracting firms.

Strobel has been employed by Conoco since being graduated from the University of Colorado in 1948 with an M.S. degree in chemical engineering. He first worked in the Process Engineering division of the Manufacturing department and is now serving as technical assistant to the manager of the Petrochemical department.

A native New Yorker, Parker holds B.Sc. and M.Sc. degrees in technical engineering from the University of Michigan. As manager of the Western headquarters of Blaw-Knox' Chemical Plants division, he is in charge of an integrated engineering, procurement and construction organization.

Four-Man Crew Writes on Work with Pebble Heater

Myron O. Kilpatrick, Lloyd E. Dean, Dick S. Hall and Kenneth W. Seed, "New Pebble Heater Process," page 171.

From Phillips Petroleum Company comes this writing crew to let readers in on what they've been doing with pebble heaters.

Myron Kilpatrick has been with Phillips since January, 1939, and has long been concerned with pebble heater development. He was in charge of the process design of the original unit and has personally directed its development into a tool for high temperature processing. A graduate of Louisiana State University, in 1937 with a B.S. degree in chemical engineering, he is presently chief process engineer in Phillips' Natural Gasoline department.

Lloyd Dean, employed by Phillips in 1941, has been associated with light hydrocarbon pyrolysis almost continuously while at the company and has supervised the pebble heater operation and development for the last few years. An alumnus of the University of Oklahoma, class of 1941, B.S. degree in chemical engineering, he is assistant chief process engineer in the Natural Gasoline department.

Dick Hall came out of the U. S. Army in 1946 and went to work for Phillips. He has since been connected with all phases of pebble heater development and is currently in charge of operation of the pebble heater unit at Borger, Texas. He received his B.S. degree in chemical engineering from the University of Nebraska in 1943.

Since being graduated from Oklahoma A. & M. College in 1950 with a B.S. degree in chemical engineering, Kenny Seed has worked with Phillips' Perco division at Bartlesville, Okla.

Duval and Kali: Two Familiar Faces

C. A. Duval and V. A. Kalichevsky, "Dualayer Gasoline Treating Process," page 161.

Duval and Kalichevsky, no strangers they!

Especially V. A. "Kali" Kalichevsky, consulting chemical engineer for Magnolia Petroleum Company, Beaumont, Texas. Kali is one of those rare individuals who have much to say and do and stay busy saying and doing it. He jumped in the refining industry swim in 1924 and has stroked steadily since.

In his ten years at Magnolia he has won wide repute for his inspiration to young engineers in his company. His books on different phases of the oil industry have won him a "name" as an author. His frequent contributions to technical publications have established him as an authority on many subjects, and his ACS activities have marked him a doer. Taken as a whole, Kali seems a crackling livewire that stays charged.

Kali's co-author, C. A. Duval has also been heard from. For August, 1952, PETROLEUM REFINER he co-authored "How Charge Stock Properties Affect Carbon Deposition in Catalytic Cracking," and for the February, 1951, issue, he authored "Accelerated Aging Test Limitations." Duval, who is also employed at Magnolia's Beaumont refinery, was born at Austin, Texas, and was graduated from his hometown school, the University of Texas, in 1941. His early assignments at Magnolia were in the Product Control Laboratories and as process engineer on Houdry and TCC units. He is presently in charge of the Light Oil section of the Process Control Laboratories.

UOP-Union Oil Group Collaborate on Unifining

H. W. Grote, C. H. Watkins, H. F. Poll and G. W. Hendricks, "Unifining," page 165

Soon after being graduated from the University of Michigan, Henry W. Grote joined Universal Oil Products Company as a chemical engineer. In that capacity he was concerned with catalyst production and testing, process design of commercial units and the construction and operation of commercial process plants. He has since advanced to manager of the Pilot Plant division and to assistant manager of UOP's Research and Development Laboratories at Riverside, Ill., his present post.

Charles H. Watkins, who received a

Meet Our Authors. . .

Packaged Compressor Plant

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This packaged compressor plant is complete with Ingersoll-Rand gas engine driven compressor, Young radiator and all necessary equipment and controls. Sizes from 110 h.p. to 550 h.p.

NATURAL GAS & OIL COMPANY has a compressor station in Sligo Field, Louisiana, which is planned for maximum use of compressor horsepower throughout the life of the wells it serves. To boost gas from low pressure wells into gathering lines the company recently installed one single-stage 550 horsepower Beaird-Ingersoll-Rand packaged compressor plant. In the future, as well head pressures fall, a second 550 horsepower unit may be installed in space already provided in the same building. Later, both compressor plants may be easily converted to two-stage units. And finally, as the well is nearing depletion, one of the compressor plants may be transferred as a complete package to another site, leaving the remaining plant to complete production.

Let us show you the economy of using Beaird-Ingersoll-Rand packaged compressor plants for gas production.

Boosts field gas —

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PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP GAS SYSTEMS

Meet Our Authors...

Ph.D. degree from Purdue University in 1939, was associated with Standard Oil Development Company until 1946, when he joined UOP. In his initial assignment to the Research and Development Lab, he engaged in research in catalytic and thermal reactions. He is now coordinator of one of the company's research divisions.

Harry F. Poll, a chemical engineering graduate of Purdue University, joined Union Oil Company of California in 1946. He has worked on pilot plants, process development and process design. Presently, as supervising process engineer, he is in charge of process engineering on Union's large expansion program at Oleum, Calif. He has been closely connected with the development of the Unifining process.

Grant W. Hendricks, native of Utah and graduate of the University of Utah, joined Union's Research department in January, 1953, following two years of advanced study at the University of Washington. As senior section leader in the Research division of Union's Research and Process department, his duties include supervision of catalyst development studies.

Wiese Well Grounded in Labor Relation Quirks

F. Roe Wiese, "Some Proposed Taft-Hartley Changes Are Dangerous to Oil," page 106.

Since joining Standard Oil Company (Indiana) in 1936, F. Roe Wiese has been engaged in practically all phases of employer-employe relations, including labor relations. Today as associate director of industrial relations for Standard, he works with the Wage Stabilization Board and problems arising out of the Taft-Hartley Law.

Wiese received a B.A. degree in business administration from the University of Iowa and a B.L. degree from George Washington University in Washington, D. C. His early experience came from a five-year law practice. Positions he has held at Standard include assistant personnel supervisor, and assistant director of industrial relations.

Ladimer Long Concerned With Aging Problems

Irving Ladimer, "How Old is Too Old," page 107.

Much of the progress made in recent years in improving the lot of the aged can in large measure be attributed to the efforts of such individuals as Irving Ladimer. A federal employe, now with the National Institute of Health, research arm of the Public Health Service, he first began working on aging problems, especially those related to benefits for various groups, in 1936 as an economist on the Social Security Board.

A lawyer, Ladimer was labor law editor at the Bureau of National Affairs from 1944 to 1945, a year after which he joined the Office of War Mobilization, which was soon thereafter merged with the White House staff. Since that time he has served the U. S. government.

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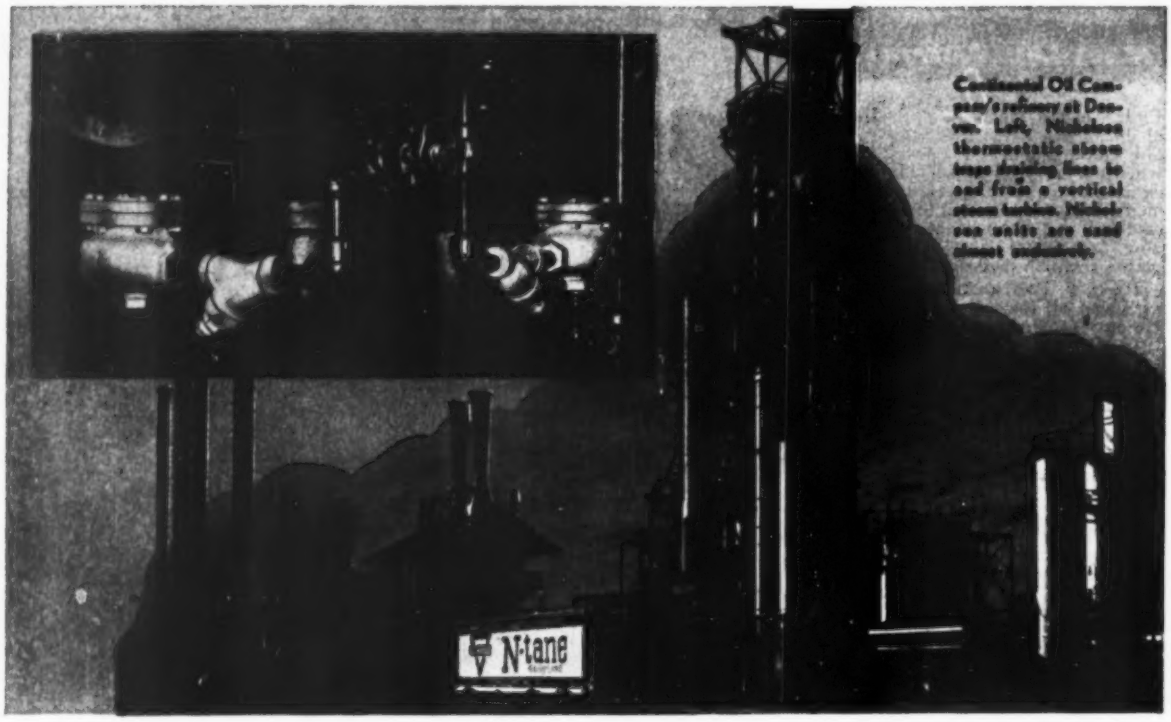

Continental Oil Company's refinery at Denver. Left, Nicholson thermostatic steam traps draining lines to and from a vertical steam turbine. Nicholson units are used almost exclusively.

NICHOLSON TRAPS SELECTED for CONOCO Refinery

This Continental Oil Company refinery has adopted Nicholson steam traps because they proved most effective generally in improving heat transfer. This is an advantage which, we believe, is important to plant men in every industry. A recent survey showed these Nicholson features to be the reasons why plants with standardization-for-economy programs are increasingly adopting Nicholson traps: (1) Two to six times average drainage capacity. (2) Operate at lower temperature differential. (3) No air binding. (4) Freeze-proof. (5) Only one moving part. (6) No change of valves for varying pressures. (7) Record low for steam waste. For process, power, heat.

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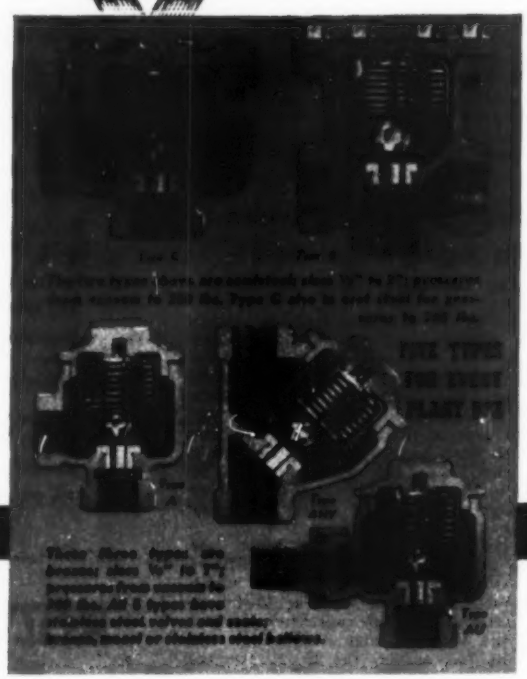

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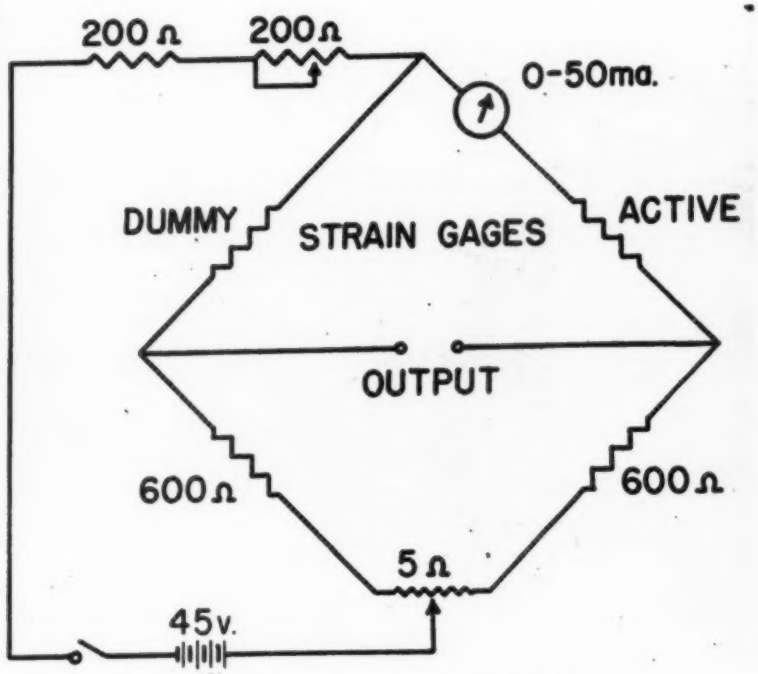
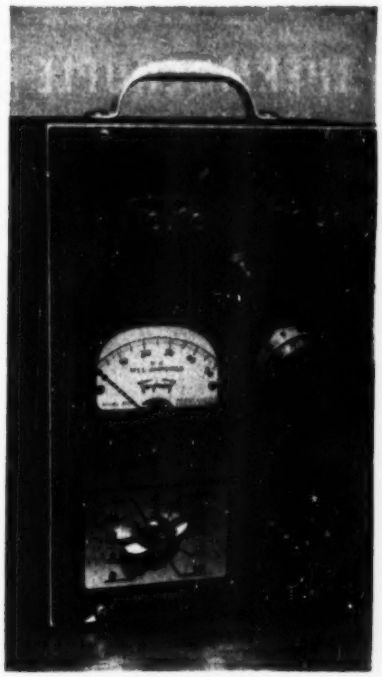


1. The bridge circuit diagram for the strain gage looks like this . . .



2. . . . But here's the assembled instrument.

Make your own . . .

Strain Gage Instrument

It requires:

- **About $50 worth of materials.**
- **Very little labor.**

Have you ever thought about using strain gages for some project—then dismissed the notion as being too expensive? Groups are frequently faced with projects requiring strain gage measurements but cannot justify the purchase of commercial instruments. Typical instances: when design groups have new ideas on vessel design, or corrosion engineers become interested in obtaining more information on stress corrosion. Such projects need not be abandoned, not when you can make your own strain gage instrument for about $50 worth of materials and a little effort.

Strain gages consist of a maze of fine wires cemented to a test member. When a load is applied, the gage stretches, and the resistance changes proportionally to the elongation. The resistance will also change with the temperature of the gage. The trick is to measure the change in resistance, which is caused by stretching, within the desired limits of accuracy.

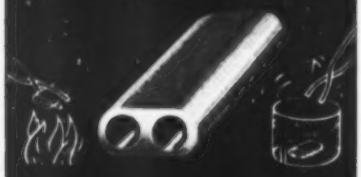
Regular Shop Equipment. Normally, a portable thermocouple millivolt indicator is part of regular shop test equipment and can serve for the precision voltage measurement. The problem then becomes simply the design of a circuit to measure small changes in resistance caused by strain only. Temperature resistance changes have to be balanced out. This can be done by a wheatstone bridge circuit with the measuring, or active, gage balanced against a dummy gage exposed to the same ambient temperature conditions. If a constant current is applied to the active gage, then the bridge output, may be read on the millivolt indicator.

Circuit Make-up. A diagram of the strain gage bridge circuit is shown in Figure 1. Two arms of the bridge are formed by SR-4 type A-6 300 ohm strain gages. The active gage is bonded to the stressed member and measures strain by resistance change. The dummy gage compensates for ambient temperature changes. The other two arms of the bridge are a pair of 600 ohm precision wirewound resistors with low temperature coefficients. A portable thermocouple millivolt indicator shows any unbalance and a 5 ohm potentiometer balances the bridge. A milliammeter indicates current through the active gage and the current is kept constant with a 200 ohm rheostat.

Strain Gage Operation. In operation, the active gage current is adjusted to 30 milliamperes, and the bridge is adjusted for null output to the millivolt indicator at no load. As the load is applied, the current is readjusted to 30 milliamperes. The bridge output voltage measured by the millivolt indicator is directly proportional to the strain. It should be noted that since the output of the bridge is in millivolts, the voltage can be

Be Certain WITH "SERV-RITE

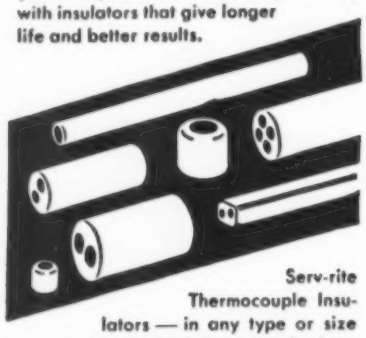
THERMOCOUPLE INSULATORS



This Gordon Thermocouple Insulator, heated red hot and plunged into cold water, came out just as good as new

Available only through GORDON, Serv-rite Thermocouple Insulators are made to stand the gaff of excessive thermal shock far above normal requirements.

For sturdy and reliable thermocouple insulator performance to meet peak production needs—specify Serv-rite . . . a development backed by Gordon's many years' experience in supplying industry with insulators that give longer life and better results.



Serv-rite Thermocouple Insulators — in any type or size — can be supplied immediately from Gordon's large stocks in the Chicago and Cleveland plants. Remember — you can always distinguish Serv-rite Insulators by their tan color.

Fish Spine Beads · Asbestos String
Asbestos Tubing · Single Hole
Double Hole Round · Double Hole Oval

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measured and recorded on any of the standard electronic type recorder controllers.

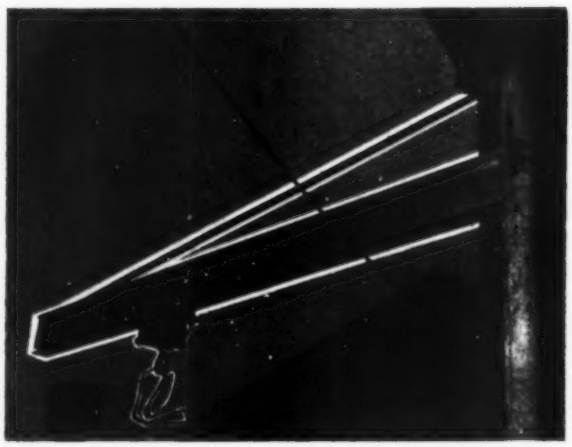
The callibration curve is a straight line and the accuracy is well within the limits of most tensile testing machines which might be used for calibration.

The assembled bridge circuit is a compact package not much larger than a cigar box. It is shown in Figure 2. Having self-contained batteries, it may be readily used in the field away from sources of power supply. Incidentally, the test leads should be matched pairs. If test leads are replaced, the instrument should be recalibrated.

How much does all this cost? If the millivolt indicator does not have to be purchased, the total cost runs about $50 for the material. In return, you have a satisfactory instrument which is adequate for most purposes.

This idea was presented at the "Symposium on Instrumentation for the Process Industries," College Station, Texas, January 29, 1954, by E. H. Collender, Celanese Corporation of America, Bishop, Texas.

Overhead Crane Handles Heavy Equipment



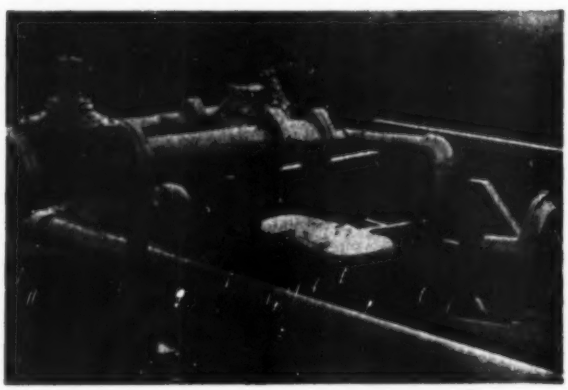
Every shop has the problem of handling heavy equipment brought in for repair. In many cases the equipment comes to the shop on a truck or trailer and then must be lifted and moved to the working area. The device shown offers one solution to this handling problem.

An 8-inch by 3-inch I-beam, 12 feet long, is welded to a 4-inch pipe. A one inch pipe running from the end of the 4-inch pipe to the end of the I-beam acts as a brace. Both ends of the pipe are mounted on the supports so that the whole assembly can be pivoted. In this case the device can be pivoted approximately 270 degrees. A trolley works along the I-beam.

The location is in the entrance to the shop. When a piece of equipment comes in, the trolley, with a hoist attached can be rolled out on the I-beam to lift the equipment off the truck. The crane can be pivoted around over the working area and positioned over the desired spot before lowering the equipment.

Time is saved because the equipment has to be handled only once. Another factor to be considered is the safety angle. Such a crane as this decreases the danger to workmen.

Sweet Gas Blanket Reduces H_2S Hazard



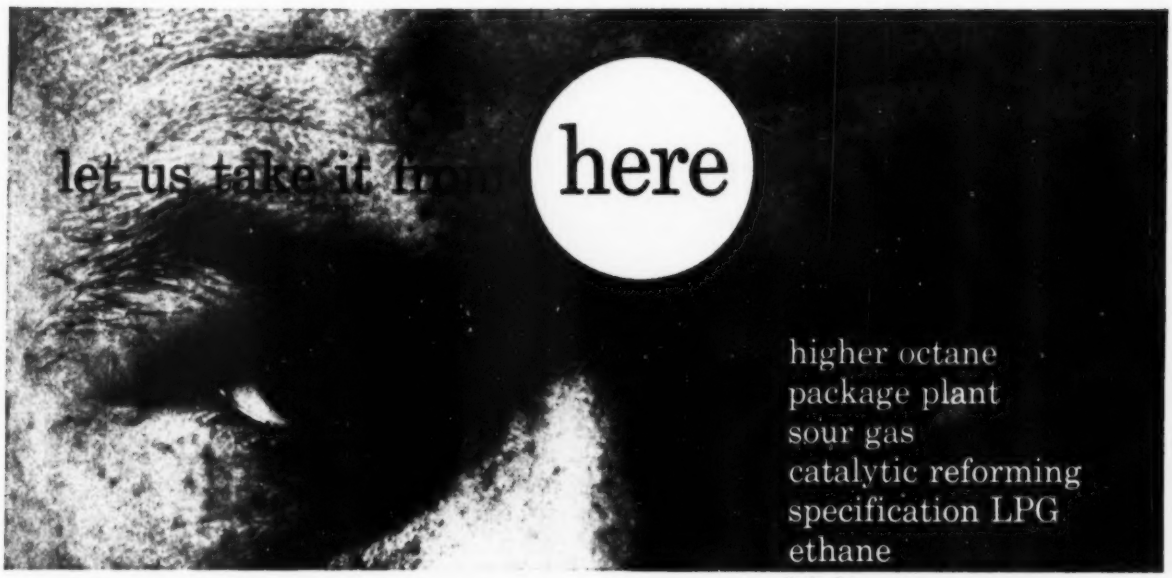
Gaging tanks containing sour crude is one of the most dangerous tasks facing a tank gager. High concentrations of hydrogen sulfide gas can paralize and kill without warning; smaller doses can cause blackouts. Tank gagers face this hazard every time they run a gaging tape through the tank hatch.

The hazard may be minimized by maintaining a blanket of "sweet" gas on top of the sour crude. Sweet gas rises in such a way that only a small amount of the H_2S gas will escape the tank when the gager opens the hatch.

Sweet gas is piped to the battery and reduced to four ounces of pressure. When the pressure exceeds four ounces a pressure regulator on the tank vent line opens. The regulator is shown at

How to Do It . . .

natural gasoline problem?



Blaw-Knox offers specialized services to the Natural Gasoline Industry covering engineering, procurement and construction of a wide range of processing plants.

Package units are available for dehydration and gasoline recovery. Custom-built plants are offered for compression, LPG and gasoline recovery and hydrocarbon separation. Conventional and special treating units are designed and built by Blaw-Knox.

Of particular interest to natural gas and gasoline processors at this time is the experience of Blaw-Knox in process plants for separation, cracking and catalytic reforming of natural gasoline fractions to produce petrochemicals and high octane, catalytically reformed gasoline.

Wire, write or phone Blaw-Knox for information concerning the solution to your natural gasoline problems.

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For more data on advertised products, use Readers' Service Cards, last page.

ACCO Registered* WIRE ROPE SLINGS

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●"ACCO *Registered*" is the registered trademark applied by American Chain and Cable Company to slings of the highest grade, but it is more than just a trademark.

"ACCO *Registered*" is a definite specification of quality in both material and design.

To be "ACCO *Registered*," a wire rope sling must meet the following specifications:

1. It must be made from high strength "Green Strand" wire rope.
2. All parts of the finished sling must have a breaking strength equal to the catalog strength of the sling body.
3. All fittings and attachments must withstand a proof-test equal to at least two times the rated capacity without permanent distortion.
4. Actual field service tests of each design.

As evidence of compliance with these requirements each sling is given a metal identification tag and is accompanied by a Certificate of Proof Test and Registry.

What does ACCO REGISTRY mean to you?

It means that you can equip your shop with "lifting tools" and be confident that their designs and materials are specifically selected for the highest efficiency by trained engineers who spend all their time on slings.

It means that you can be sure that your men, materials, and machines are given the highest protection against injury during lifting operations.

Where can you get ACCO REGISTERED SLINGS?

To make ACCO *Registered* Slings immediately available for your requirements, American Chain and Cable Company, Inc. has appointed one of the best industrial supply houses in your community as an ACCO *Registered* Sling distributor. Selection for such appointment is made on the basis of the distributor's desire to serve you, his grasp of your problems, and his willingness to maintain in his stock sizes and types of slings you need.

See your ACCO *Registered* Distributor or write to us for literature and his name.

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ACCO

Wire Rope Sling Department
AMERICAN CHAIN & CABLE

Wilkes-Barre, Pa., Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

How to Do It . . .

left in the photo. The vent line, of 4-inch pipe, is equipped with a bypass line around the regulator, so that the line may be opened to the atmosphere to take some of the gas off the tank prior to gaging. The bypass is controlled by a quick-action two-way valve located on the gas vent riser just in front of the gage hatch.

Just before gaging a tank of sour crude, the gager throws the two-way valve to bypass the regulator, waits a moment, then opens the gage hatch to make his tank gage.

A-Frame Shelves Permit Convenient Valve Storage

A good way to keep reconditioned valves available and convenient for inventory and selection is to store them in a central yard on an A-frame rack.

Construction of the rack for storing the valves is simple. A-frame type supports are welded to horizonal sections of casing which have been split down the middle. Each storage rack, measuring about 20 feet in length, is made up of three A-frame members similar to the one shown above. The sloping legs of these frames support three horizontal "shelves" made from the split casing. This casing is mounted on the A-frame by welding a piece of plate steel webbing so that a saddle fits snugly around the bottom of the round casing section.

Valves of all types and sizes may be stored in the shelves for future use. A good practice might be to place the lightweight valves of smaller sizes on the top shelf, medium sized valves on the middle shelf, and heavy, larger valves on the bottom shelf.

For more data on advertised products, use Readers' Service Cards, last page.

WHEN TEMPERATURE IS A PRIME FACTOR

Many variables are involved in the selection of the optimum tubing for a specific high temperature application. If the tubing is also to operate under high stress, perhaps the most important variable to be considered is mechanical strength.

In general, the mechanical strength of a steel decreases as the temperature increases. Some steels, however, retain more of their strength at elevated temperatures than others. For instance, at 300F, the ultimate strength of both carbon steel and B&W Croloy 18-8 (Type 304) is about 70,000 psi. At 1200F, however, carbon steel is about 12,000 psi while Croloy 18-8 is about 44,000 psi.

To evaluate the characteristics of metals operating under stress at high temperatures and over long periods of time, B&W has performed stress rupture tests and creep tests on a great number of tubing steels.* The results of these tests help engineers to determine the proper tube to be used in specific applications.

Other factors beside mechanical strength, however, must be considered in choosing the optimum tubing for a specific high temperature application. Some of these factors are—oxidation resistance, tube size, tube cost, flow rates, and rates of conductivity and expansion.

It takes an expert to specify the right tubing for any particular application, and there is no substitute for the kind of experience with these problems you'll find at B&W.

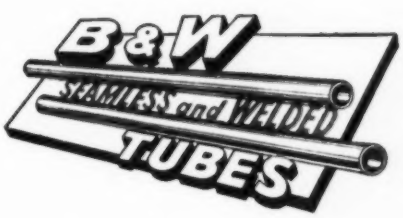
To get the most benefit from B&W's long experience in matching tubes to jobs, call on Mr. Tubes, your nearby B&W Tube Representative. He can help you make the best choice.

***Data shown in**

TDC 102 Creep Stress Data on B&W Croloys

TDC 153 Stress Rupture Data on B&W Croloys available free on request.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing



TA-4023 (P)

For more data on advertised products, use Readers' Service Cards, last page.

Many processes are available to the refiner who is projecting a refinery from a given crude. The selection of these various processes at each step of the way is obviously important — both economically and to meet required product specifications.

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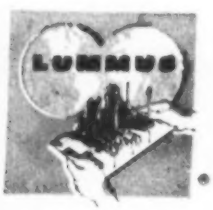

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Construction Capsules

Westoil Terminals Company plans to expand its San Pedro, Calif., refinery and will install catalytic cracking and polymerization facilities.

McBride Oil and Gas Corporation will expand its Port Brownsville, Texas, refinery as a result of a contract signed with Petroleos Mexicanos, the Mexican government oil agency, which calls for McBride to purchase 7500 barrels a day of Mexican crude. Elsewhere in the McBride organization, permission has been received from British Guiana for the company to build a refinery there. The proposed British Guiana refinery will operate on imported crudes until local supplies can be set up. McBride also was granted an exploration concession which covers 296,000 acres in that country.

Sterling Oil of Oklahoma, Inc., has completed its new gasoline plant near Garber in Garfield County, Okla. The $500,000 plant starts off processing about 100 Mmcf of gas a day but will have a maximum capacity of 140 Mmcf.

Hancock Oil Company of California plans a $5 million expansion at its 12,000-barrel-a-day Long Beach, Calif., refinery, including installation of a Socony-Vacuum licensed Thermofor catalytic cracking unit with a 6000-barrel-a-day capacity and a UOP catalytic polymerization plant with a capacity of 500 barrels a day.

Dow Chemical of Canada, Ltd., has awarded The Fluor Corporation, Ltd., a contract for engineering and construction of an ammonia plant expansion at Sarnia, Ontario, Canada. Construction on the $3 million project will start soon, with completion scheduled for this summer. Fluor's associate, H. G. Acres & Company, Ltd., of Niagara Falls, Ontario, will do the engineering.

Frontier Refining Company has increased the capacity of a catalytic cracking unit at its Denver, Colo., refinery from 2600 to 6500 barrels a day. It has also installed a new cooling tower and expanded a polymerization unit.

Osceola Refining Company plans to study the 4000-barrel-a-day skimming and asphalt plant which it recently bought from Producers Refining Company with the purpose of possibly modernizing and reopening the plant, which has been idle since November, 1953.

Blaw-Knox Company has been awarded the contract for construction of a new natural gas compressor plant near Sterling, Colo., for Paul F. Barnhart, J. Ray McDermott & Company, Inc., Kansas-Nebraska Natural Gas Company, Inc., The Texas Company, Bay Petroleum Corporation, and Shell Oil Company, which are jointly building the plant. To serve both the Mount Hope and Walker fields, it will be capable of compressing 4500 mcf of gas a day from field pressure of 5 psi to 800 psi.

Shell Refining (Australia) Proprietaries, Ltd., has started production at its new refinery at Geelong, 40 miles outside Melbourne, Australia. A 28,000-barrel-a-day crude distillation unit is still under construction at the refinery and is expected to be completed this year. The refinery is presently the largest in Australia.

The Texas Company plans to begin construction this year of catalytic reforming facilities at its Los Angeles, Tulsa, Lockport and Lawrenceville, Ill., refineries. The company will build a second catalytic reforming unit at its Port Arthur, Texas, refinery and an alkylation unit at Lawrenceville.

Standard Oil Company of California has put on stream the first plant in the world to produce phenol from 100 percent petroleum sources at Richmond, Calif. The 35-million-pound-a-year phenol-from-cumene plant is the first in the U. S. to use Hercules Powder Company's cumene process. Oronite Chemical Company, a Standard subsidiary, will market the phenol and 20 million pounds of acetone, a by-product.

SOHIO'S SUCCESS

Continued from page 109

LPG and natural gasoline, are then separated in a fractionating tower and sent to storage.

Safety. The plant has its own fire fighting facilities composed of dry chemical type fire extinguishers and a water and liquid foam system. In addition to the fire protection equipment, there is an emergency shutdown system, manually operated from two stations located within the plant area, and arranged to shut down the compressor, shut off fuel gas to the heaters and flare all incoming gas.

Born Engineering Company of Tulsa was the engineering contractor for the plant, and Voigt-Frailey, Inc., of Perry, Okla., was the gas pipe line contractor.

Who's Building . . .

Gulf Ready to Start on Huge Port Arthur Plant

Initial work on a multimillion dollar ethylene plant is expected to begin right away at Gulf Oil Corporation's Port Arthur, Texas, refinery.

Stone & Webster Engineering Corporation's Badger Process Division is general contractor on the project. Selas Corporation of America is furnishing the heating units (eight radiant-heat furnaces).

The new ethylene plant is one of two gigantic projects, each the largest of its kind in the world, which Gulf has planned. The other project is a 20,000-barrel-a-day platformer, which will be built by The Fluor Corporation, Ltd.

The ethylene unit will have a capacity of 3000 Mmcf of ethylene gas a year, enough to double the refinery's present ethylene capacity. Cost of the two units was not given but it is believed that the ethylene plant will be built for $18 to $20 million.

Jefferson Lake Schedules Construction in Wyoming

Groundbreaking for Jefferson Lake Sulphur Company's plant near Worland, Wyo., to recover sulfur from "sour" gas in the Manderson field has been scheduled for early this month. Initial capacity of the $750,000 plant will be 145 to 150 tons of sulfur daily.

Under the company's present plans, as the Manderson field is developed, the capacity of the plant will be raised to 300 to 400 tons a day. Ralph Parsons Company will build the plant and also a gas processing plant for Manderson field producers. Jefferson Lake will receive hydrogen sulfide gas from the gas plant and process it into sulfur.

Gasoline Plant Leads Write-Offs

The Office of Defense Mobilization has issued rapid tax write-off certificates for 11 more refining and related projects, including an $8.4 million natural gasoline plant to be built in Floyd County, Ky.

Kentucky-West Virginia Gas Company was granted a write-off of 65 percent on $8,449,000 for the plant, which is to process 80 Mmcf a day of natural gas into 407 barrels a day of natural gasoline, 3278 barrels a day of LPG products and 5156 mcf a day of ethane. Kentucky-West Virginia Gas' planned natural gasoline plant was the highest grant on ODM's latest list of approved projects.

Standard Oil Company (Indiana) received the second highest write-off, getting approval on a 12,000-barrel-a-day fixed-bed hydroformer for production of high-octane gasoline components from low-octane naphtha at its Sugar Creek, Mo., refinery. Standard was given write-offs of 65 percent on $5,361,000, 45 percent on $861,000, and 15 percent on $42,800.

Indiana Standard also received the third highest grant on the 3750-barrel-a-day fixed-bed hydroformer it will build at its Mandan, N. Dak., refinery. It received certificates on this project calling for write-offs of 65 percent on $2,015,900, 40 percent on $747,900, and 15 percent on $53,000.

Other projects receiving ODM approval for fast tax write-offs, with company, location, facility involved, total cost approved and percentages of that cost certified, were:

Warren Petroleum Company—Garvin County, Okla., facilities at the Antioch unit of the company's natural gasoline plant for extraction of 3643 barrels a day of liquefied petroleum gas from 34,000 Mmcf a day of separator gas preparation of residual dry gas for sale, and delivery of LPG mixture to Maysville plant for fractionation into propane, butane and natural gasoline, $2,786,490 at 65 percent.

Warren Petroleum Company—Lindsay, Okla., facilities for extraction of

See WHO's BUILDING Page 246

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Construction Boxscore: Refineries and Other Plants . . .

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licenser	Engineering	Contractor
EAST									
Allied Chemical	Hopewell, Va.	Syn. Nitrogen	†50,000 tons yr.	$12.5 million					
Allied Chem. & Dye	Buffalo, N.Y.	Aromatic Fac.		$6,940,000	PAD Certified				
Atlantic Refining	Philadelphia	Two Stage Crude Dist.	45,000 bbls.		Under Constr.			Foster Wheeler	Foster Wheeler
California Oil Co.	Barber, N.J.	Revamp Thermal Reformer to Cat. Reformer	10,700 bbls.		Under Constr.	1954	U.O.P.	U.O.P.	Bechtel
The California Oil Co.	Perth Amboy, N. J.	Inc. Cap. of Cat Cracker	†3,000 bbls.	$1,350,000	Completed			Braun	Bechtel
E. I. du Pont de Nemours	Kinston, N.C.	Dacron Polyester Fiber		$3,000,000	Planning	1954			
Esso Standard	Everett, Mass.	Propane Plt.	870 bbls.		Under Constr.	2nd Qtr., 1954		S.O.D.	
*Esso Standard	Linden, N.J.	Cat. Poly. Plt.	9,100 bbls.		Announced	1st Qtr., 1955		S.O.D., Braun	Braun
Esso Standard	Linden, N.J.	Crude Pipe Still	60,000 bbls.		Under Constr.	2nd Qtr., 1954		S.O.D., Kellogg	Kellogg
Esso Standard	Linden, N.J.	Hydrofining	21,500 bbls.		Under Constr.	2nd Qtr., 1954		S.O.D., Braun	Braun
Esso Standard	Everett, Mass.	Asphalt Vacuum Tower	13,100 bbls.		Under Constr.	2nd Qtr., 1954	S.O.D.		
B. F. Goodrich Chemical Co.	Calvert City, Ky.	Chemical Plt.		$8,000,000	Engineering	4th Qtr., 1954		Fluor	Fluor
Gulf	Philadelphia	Crude; Atoms. & Vacuum Unit	125,000 bbls.		Under Constr.	Summer, 1954		Foster Wheeler	Foster Wheeler
Gulf Oil Corp.	Philadelphia	Sulfur Recovery		$1.1 million	DPA Certified				
Gulf	Philadelphia	Gasoline Sweet	40,000 bbls.		Completing			Gulf	Gulf
Gulf	Philadelphia	Cat. Poly.	10,000 bbls.		Completing			Bechtel	Kellogg
Gulf	Philadelphia	Cat. Cracker	63,000 bbls.		Completing			Kellogg	Kellogg
*Hercules Powder Co.	Burlington, N.J.	Dimethyl Terephthalate Plt.			Planned				
Hercules Powder	Gibbstown, N.J.	Petrochemicals		$8 million	Under Constr.	Sept., 1954		Kellogg	Kellogg
Monsanto	Springfield, Mass.	Polyvinyl chloride resin		$1.2 million	Announced				
Pan American Refining Corp.	Yorktown, Va.	Refinery	25,000 bbls.	$25,000,000	ODM Approved				
Pennsylvania Industrial Chemical Corp.	Jefferson, Pa.	Petrochem. Plt.			Under Constr.	Summer 1954			
Pennzoil Co.	Rouseville, Pa.	Expan. Two-Stage Distil.	12,000 bbls.	$1,500,000	Under Constr.	July, 1954		Kellogg	Kellogg
*Quaker State Oil Refining Co.	Emlenton, Pa.	Gaso. Processing Unit	850 bbls.		Projected				Procon
*Quaker State Oil Refining Co.	St. Mary, W.Va.	Gaso. Processing Unit	850 bbls.		Projected				Procon
Sinclair Refining	Marcus Hook, Pa.	Cat. Reforming	16,000 bbls.	$14,000,000	Projected	Summer, 1954			Braun
*Sinclair Refining Co.	Marcus Hook, Pa.	Para-Xylene Plt	10 million lbs. year		Planned	1st Qtr., 1955			
Texas Company	Westville, N. J.	Cat. Reforming	12,000 bbls.		Under Constr.	4th Qtr., 1954		U.O.P., Procon, Others	Procon & Others
Texas Company	Westville, N.J.	Alkylation Fac.	1,850 bbls.		Under Constr.	4th Qtr., 1954		Procon, Others	
Union Carbide & Carbon Corp.	Leaksville, N.C.	Dynel Fiber Plt.		$30,000,000	Planning	1955		Staff	
United Refining Co.	Warren, Pa.	Lab.			Under Constr.				
MID-CONTINENT									
Allied Chemical & Dye Corp.	South Point, O.	Synthetic Nitrogen	50,000 tons yr.	$12.5 million	Design				
Allied Chemical & Dye	Cleveland, Ohio	Chemical Plt.		$2,000,000	Under Constr.	1954		Staff	M-C & S.
★ Amerada Pet. Corp.	Williston, Basin, N. D.	Natural Gasoline Plt.		$10 million	Planning				
American Mineral Spirits Co.	Toledo, Ohio	Alkylation Unit (Sulfuric Acid)		$2,500,000	Planning				
Aurora Gasoline	Detroit, Mich.	Basic Refining		$400,000	Announced				
Bay Refining Corp.	Bay City, Mich.	Cat Cracker	6,000 bbls.	$3,000,000	Under Constr.	Fall, 1954		Sweco	Sweco
		Cat Poly Auxiliary Equipment	300 bbls.						
*Ben Franklin Refining Co.	Ardmore, Okla.	Vacuum Distil. Unit			Under Constr.		U.O.P.		
The Carter Oil Co.	Billings, Mont.	Fluid Coking Unit	3,800 bbls.		Design	Late 1954	Std. Oil Dev. Co.		Fluor
★ Central Petroleum Co.	Coyle, Okla.	Gasoline Plt.			Authorized				
Cities Service Oil Co. (Del.)	E. Chicago, Ind.	Topping Unit,	30,000 bbls.	$2 million	Under Constr.	1954		McKee	McKee
		Fluid Hydroformer	12,780 bbls.	$4 million	Under Constr.	1954		Kellogg	Kellogg
*Cities Service Oil Co.	E. Chicago, Ill.	Add. Delayed Coking Fac.			Under Constr.				
Continental Blacks, Inc.	Ponca City, Okla.	Carbon Black Plt.	140,000 lbs.	$2,715,175	Completing			Fish	Fish
Continental Oil	Ponca City, Okla.	Expansion	None	$7.5 million	Under Constr.	Summer, 1954	Continental	Staff	Staff
Cooperative Farm Chemicals Assn.	Lawrence, Kans.				Under Constr.	August, 1954	Texaco Dev., Casale	Foster Wheeler	Foster Wheeler
*Dakota Oil & Refining Co.	Minot, N. Dak.	Refinery	2,500 bbls.		Negotiating Finance				
Deere & Company	Pryor, Okla.	Ammonia Plt.	180 tons		Completing		Texaco Dev.	Foster Wheeler	Foster Wheeler
		Urea Plt.	270 tons					Foster Wheeler	Foster Wheeler
Derby Oil	Wichita, Kans.	Platforming Unit		$2,700,000	Under Constr.				
Dow Chemical	Midland, Mich.	Hypersorption Unit			Completed		Union Oil (Calif.)	Foster Wheeler	Foster Wheeler
Dow Chemical	Ludington, Mich.	Bromine for TEL	2 million lbs. yr.	$433,500	Completed				
Dow Chemical	Midland, Mich.	Ethylene Dibromide		$370,000	Completed				
E. I. DuPont de Nemours	Circleville, Ohio	Mylar Polyester Plt.		$10,000,000	Under Constr.	Early, 1955			
Grace Chemical	Memphis, Tenn.	Ammonia Plt., & Urea	250 tons	$19,000,000	Under Constr.	Summer, 1954	Texaco Dev., Casale & Pechiney	Foster Wheeler	Foster Wheeler
Great Northern	St. Paul, Minn.	Crude Topping	30,000 bbls.						
Great Northern Oil	St. Paul	Cat. Crk.	7,620 bbls.	$26 million	Planned				Lummus
Great Northern	St. Paul	Cat. Reformer	6,000 bbls.						
Great Northern	St. Paul	Cat. Poly.	680 bbls.						

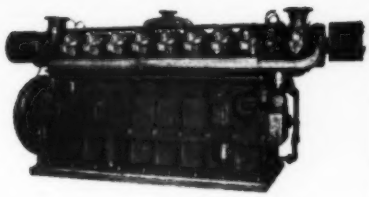
★ Natural gasoline plants under construction or expansion.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

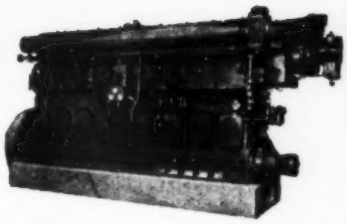
COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
*Gulf Oil Corp.	Toledo, Ohio	Refinery Fac.; Platformer	10,000 bbls.		On Inquiry				
Gulf Oil	Cincinnati, Ohio	Canning Plt.			Announced				
*International Refineries	Wrenshall, Minn.	Petroleum Refining Facil.		$9,500,000	ODM Approved				
*Kerr-McGee Industries, Inc.	Wynnewood, Okla.	Fluid Type Cat Crker, Gas. Plt. & Cat. Poly Unit	6,000 bbls. of Fresh Gas-Oil Feed	$2,500,000	Under Constr.	Nov., 1954	U.O.P.	Ref. Eng.	Ref. Eng.
Kerr-McGee Industries, Inc.	Wynnewood, Okla.	Expan. of Crude Still Fac.	15,000 bbls.	$500,000	Completing			Kock	Kock
*Kerr-McGee Industries, Inc.	Wynnewood, Okla.	Offsite Facilities		$1,500,000	Under Constr.	Nov., 1954		Koch, Others	
Michigan Chem.	St. Louis, Mich.	Sulfuric Acid		$127,167	Completed			Staff	Staff
Mid-Continent	W. Tulsa, Okla.	Cat. Reformer	7,500 bbls.	$2,500,000	Under Constr.	June, 1954	Atlantic	Kellogg	Staff
*Mid-Continent Petroleum Corp.	W. Tulsa, Okla.	Inc. in Alkalation Cap.	†500 bbls.		Constr. to begin Mid-Summer	Fall, 1954			
Minnesota Mining	Copley Twp., Ohio	Sulfuric Acid Fac.	100 tons	$750,000	Completed		Monsanto	Monsanto-Leonard	Leonard
Mississippi Chemical	Yazoo City, Miss.	Ammonia Plt.	90 tons	$2,800,000	Proposed	Late, 1954 Part, Balance Summer 1955	L'Air Liquide	Girdler	
Mississippa Chemical	Yazoo City, Miss.	Nitric Acid Plt.	120 tons	$575,000	Engineering Started	Aug., 1954	Du Pont	Chemical & Industrial	Chemical & Industrial
Mississippa Chemical	Yazoo City, Miss.	Prilled Ammonium Nitrate	400 tons	$750,000	Planning	Aug., 1954		Staff	Staff
Missouri Farmers Association	Joplin, Mo.	Fertilizer Plt.	220 tons	$3,500,000	Under Constr.	1954		Dorr Co.	M-C & S.
Monsanto Chemical	Addyston, Ohio	Styrene Plastics			Plan				
National Distillers Products	Tuscola, Ill.	Synthetic Ammonia Plt.	30,000 tons/yr.	$7,000,000	Planned	End 1954		Kellogg	
*National Petro-Chemicals	Tuscola, Ill.	Polyethylene Facilities	25 million lbs./yr.		Foundations Started	1955	I.C.I.	Kellogg	Kellogg
Ohio Oil Company	Robinson, Ill.	Houdriforming	8,000 bbls.		Completed		Houdry	Houdry	Cat. Constr.
Ohio Oil	Robinson, Ill.	Cat. Cracker Expansion	18,000 bbls.		Completing		U.O.P.	Staff	Staff
		Cat. Poly Expan	4,800 bbls.		Planning	May, 1954		Staff	Staff
		Alkylation Unit	1,500 bbls.	$1,800,000	Contracted		U.O.P.	Parsons	Parsons
Pana Refining Co.	Pana, Ill.	Modernization	†1,600 bbls.	$900,000					
Pana Refining	Pana, Ill.	Girbotol Unit			Under Constr.				Parker
Pan-Am Southern	El Dorado, Ark.	Ultraformer	7,200 bbls.	$2,900,000	Under Constr.	July, 1954	Standard (Ind.)	Standard, Lummus, Pan Am.	Lummus
*Prime Oil Co.	Calumet City, Ill.	Refinery	15,000 bbls.	$10,000,000	Planned				
The Pure Oil Co.	Heath, Ohio	Cat. Reformer	3,000 bbls.		Under Constr.	2nd Qtr., 1954			Kellogg
*Rock Island Refining	Indianapolis, Ind.	Platformer	2,000 bbls.	$600,000	ODM Approved	June, 1954	U.O.P.	U.O.P.	Staff
Shell Oil Co.	Wood River, Ill.	Offsite Fac.			Under Constr.			Fluor	Fluor
Shell Oil	Wood River, Ill.	Expansion and Improvement	†50,000 bbls.	$42.5 million	Under Constr.	Late 1954		Shell	Foster Wheeler, Fluor & McKee
Shell Oil Company	Wood River, Ill.	Platforming Unit	16,000 bbls.		Under Constr.		U.O.P.	U.O.P.	Procon
★ Shell Oil Co.	Elk City, Okla.	Cap. Increase	†70 Mmcf.	$4,400,000	Completing			Fluor	Fluor
★ Signal Oil & Gas	Tioga, N.D.	Nat. Gaso. Plt.	40,000 gals.	$9,500,000	Under Constr.	1954		Pritchard	Brown & Root
★ Signal Oil & Gas Company	Carter Co., Okla.	Nat. Gas Plt.	40 Mmcf.	$4,000,000	Under Constr.	July, 1954		Hudson	Hudson
Sinclair Refining	Hartford, Ill.	Asphalt Fac.		$600,600	Completing			Staff	Staff, Flori Pipe
Sinclair Refining	E. Chicago, Ind.	Barrel House Fac.		$2,700,000	Design	Summer, 1954			
Sinclair Refining	E. Chicago, Ind.	Power Plt. Addi.		$570,000	Design	Summer, 1954			
Sinclair Refining	E. Chicago, Ind.	Gaso. Fract. Unit	20,000 bbls.	$1,300,000	Under Constr.	Fall, 1954		Graver	Graver
*Sinclair Refining Co.	E. Chicago, Ind.	Cat. Reformer	16,000 bbls.		Contract Awarded	Early, 1955			Braun
Skelly Oil	Velma, Okla.	Booster Station			Postponed				
*Skelly Oil Co.	El Dorado, Kan.	Cat. Reformer	7,500 bbls.		Projected		U.O.P.		Skelly
Socony-Vacuum Oil Co.	Augusta, Kan.	Cat Reforming			Under Constr.	Nov., 1954		Bechtel	Bechtel
Socony-Vacuum Oil Co.	Trenton, Mich.	Cat Poly.			Complete		Calif. Res.	Badger Mfg.	Badger Mfg.
Socony-Vacuum	E. St. Louis, Ill.	Alky. Expan.	775 bbls.	$260,000	Design	Sept., 1954		Soc-Vac	Soc-Vac
Socony-Vacuum	E. St. Louis, Ill.	TCC	15,000 bbls.		Under Constr.	Sept., 1954	Soc-Vac.	Lummus	Lummus
Socony-Vacuum	E. St. Louis, Ill.	Cat. Poly.			Under Constr.	Sept., 1954	Calif. Res.	Lummus	Lummus
Standard-Indiana	Wood River, Ill.	Ultraformer	9,000 bbls.		Design	Late 1954			
Standard (Indiana)	Mandan, N.D.	New Crude Ref.	30,000 bbls.		Under Constr.	Late, 1954			Lummus
Standard (Indiana)	Whiting, Ind.	Fluid Hydroformer	27,000 bbls.		Design	Early, 1955			
Standard (Indiana)	Whiting, Ind.	Motor Oil Exp.	21,600 gals.		Under Constr.	Late, 1954			
Standard Oil of N.D.	Grand Forks, N. Dakota	Refinery	2,000-2,500 bbls.		Planning				
The Standard Oil Co. (Ohio)	Lima, Ohio	Platformer	12,000 bbls.	$8 million	Under Constr.	July, 1954	U.O.P.	U.O.P.	Procon
★ Sterling Oil of Okla., Inc.	Garber, Okla.	Gaso. Ext. Plt.	10 Mmcf		Completing			Staff	Voigt-Fraley
Sun Oil Co.	Toledo, Ohio	Catalytic Reforming Unit	10,000 bbls.	$7,200,000	Completing		U.O.P.	Procon-Sun	Procon-Catalytic
Sunray Oil	Duncan, Okla.	Platforming Unit	5,000 bbls.	$1,300,000	Under Constr.	Aug., 1954	U.O.P.	U.O.P.	Ref. Eng
Sunray Oil	Duncan, Okla.	Coking Unit	7,000 bbls.	$4,000,000	Under Constr.	Oct., 1954		Lummus	Lummus
The Texas Co.	Lawrenceville, Ill.	Cat. Reformer	13,631 bbls.		Under Constr.	2nd Qtr., 1955		U.O.P.	Lummus, Others
	Lawrenceville Ill.	Alkylation Unit	2,253 bbls.		Under Constr.	2nd Qtr., 1955		Lummus, Others	
*The Texas Co.	Lockport, Ill.	Platformer	10,854 bbls.		To Start: 3rd Qtr., 1954	3rd Qtr., 1955			
*The Texas Co.	Lockport, Ill.	Alkylation Plt.	1,000 bbls.		To Start: 3rd Qtr., 1954	3rd Qtr., 1955			
Texas Co.	Sunburst, Mont.	Cat. Poly. Unit	37,200 bbls.		Completing				
*Vulcan Asphalt Refining Co.	Cordova, Ala.	Relocation of Refinery	2,200 bbls.	$122,700	ODM Approved				
★ Warren Petroleum	Lindsay, Okla.	Nat. Gaso. Plt.			Design	1954		Gas Plt. Constr.	Gas Plt. Constr.
★ Warren Petroleum	Maysville, Okla.	Nat. Gaso. Plt.			Design	1954		Gas Plt. Constr.	Gas Plt. Constr.
Williston Basin Refining Corp.	Williston, N. Dak.	Refinery	1,500 bbls.	$425,000	Completing				
Wood River Oil Refining	Calumet, Ill.	Crude Topping, Crk.; Poly.	15,000 bbls. 6,800/600 bbls.	$1 million	Design				
SOUTHWEST									
Allied Chemical & Dye (Solvay)	Orange, Texas	Petrochemicals Unit		$5 million	Completing				

★ Natural gasoline plants under construction or expansion.

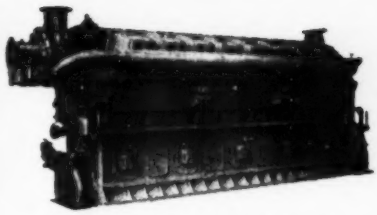
● Continued on page 201



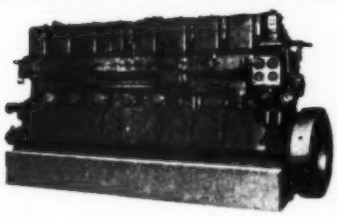
TYPE FVA ..... 8, 12 or 16 cyl.
Diesel — Atmospheric ..... 430 to 1150 hp.
Diesel — Supercharged ..... 1110 to 2230 hp.



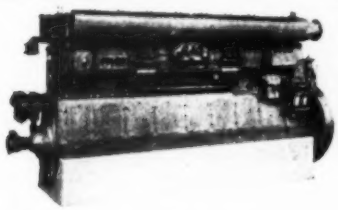
TYPE LS ..... 6, 7 or 8 cyl.
Atmospheric and Supercharged
Gas ..... 720 to 2500 hp.
Diesel ..... 825 to 2500 hp.
Gas-Diesel ..... 825 to 2500 hp.



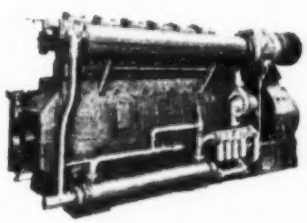
TYPE LSV ..... 12 or 16 cyl.
Atmospheric and Supercharged
Gas ..... 1440 to 5000 hp.
Diesel ..... 1650 to 5000 hp.
Gas-Diesel ..... 1650 to 5000 hp.



TYPE JS ..... 5, 6, 7 or 8 cyl.
Atmospheric and Supercharged
Gas ..... 375 to 1815 hp.
Diesel ..... 430 to 1815 hp.
Gas-Diesel ..... 430 to 1815 hp.



TYPE GS ..... 5, 6 or 8 cyl.
Atmospheric and Supercharged
Gas ..... 320 to 1460 hp.
Diesel ..... 300 to 1460 hp.
Gas-Diesel ..... 300 to 1460 hp.



TYPE FW ..... 8 cyl.
Diesel — Atmospheric ..... 245 to 500 hp.
Diesel — Supercharged ..... 350 to 835 hp.

it pays to meet power and compressor needs

"right on the nose" . . with COOPER-BESSEMERS

• Think a moment about the importance of meeting engine or compressor needs with machines that are exactly *right* for the job. With Cooper-Bessemers you have this assurance, as evidenced by the broad range of units shown here — all standard, proved Cooper-Bessemers, engineered to give *maximum* return in any kind of service you can name, from 300 to 5,000 bhp. Note, too, the flexibility offered by each basic engine type — in number of cylinders, aspiration, horsepower range and fueling.

As important as these things are in meeting your requirements without needless waste *or* shortcomings, Cooper-Bessemers have long been known for additional plus values . . . sturdiness, long life, low maintenance and unmatched efficiencies for lower over-all cost every time! There are new bulletins, yours for the asking, to give you the latest information on Cooper-Bessemer engines or compressors just right for your needs.

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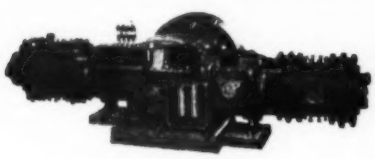


TYPE EM
To 350 hp.
9" stroke
Speed to 514 RPM

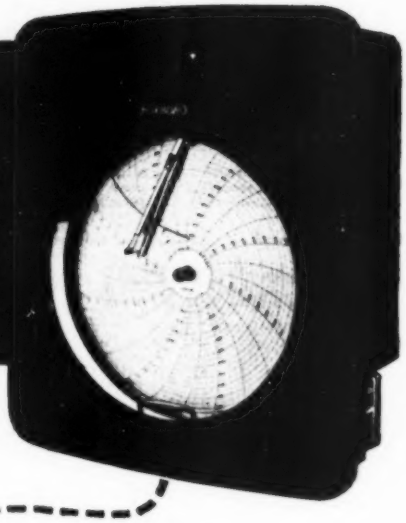
TYPE FM
To 1500 hp.
10½" stroke
Speed to 514 RPM

TYPE JM
500 to 3000 hp.
14" stroke
Speed to 327 RPM

For more data on advertised products, use Readers' Service Cards, last page.

An unbeatable team for temperature measurement

DYNALOG RECORDERS and DYNATHERM BULBS



You can't beat this Foxboro Dynalog-Dynatherm combination for insuring better temperature measurement on any job between −100° and +600°F. It gives you every advantage of speed, accuracy, long leads, simple installation, economy, and freedom from maintenance. This is why:

The Dynalog Electronic Recorder has an exclusive variable-capacitor measuring system which eliminates slidewires, gears, cables, high speed balancing motors . . . no dead space, no batteries to standardize, no motors to service. Standard full-scale pen speed only 3 seconds. Sustained accuracy ¼ of 1% guaranteed. Available for spans as narrow as 5°F. with full-accuracy calibration.

The Dynatherm Resistance Bulb has unique features including metal-to-metal end-contact which, when installed in a well or socket, gives a speed of response unsurpassed by any other similarly protected temperature-sensitive element. Exceptionally rugged and permanent in calibration.

These are only a few of the important advantages of this better temperature measuring system . . . available also for control of temperatures, or with Multi-Record Dynalog Recorder for up-to-6 records on one chart. Write for illustrated bulletins, The Foxboro Company, 744 Neponset Ave., Foxboro, Mass., U.S.A.

for any range between −100° and +600°F.

FOXBORO INSTRUMENTATION

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
American Cyanamid Company	New Orleans, La.	Anhydrous Ammonia Plt.	300 tons	$50 million	Under Constr.	1954	.....	Chemico	Chemico
American Liberty Oil Co.	Mt. Pleasant Texas	Treating Unit	.....	$3,500,000	Completing	.....	Suc-Vac.	Fluor	Fluor
		Crude Revamp	.....	.....	Completing	.....	Suc-Vac.	Fluor	Fluor
American Petro-Chemical Corp.	Lake Charles, La.	Polyethylene Plt.	$15-20 million	.....	Planned	.....	.....	.....	.....
Atlantic Refining Co	Atreco, Texas	Cat. Reforming	7,500 bbls.	.....	Contracted	.....	.....	.....	Ferguson
★ *Barnhart Hydrocarbon Corp.	Big Lake, Texas	Residue Gas Treater	20 Mmcf	.....	ODM Approved	Aug., 1954	.....	Fish	Fish
★ H. W. Bass & Sons, Inc.	Arkansas Co., Texas	Nat.Gas.	.....	$3 million	DPA Certified	.....	.....	.....	.....
★ *Cities Service Oil Co., et al	Seminole, Texas	Nat. Gas Plt.	55,000 gals.	.....	Under Constr.	.....	.....	Delta	Delta
★ Cities Service Oil	Pampa, Texas	Gasoline Expan.	.....	$222,139	Certified DPA	.....	.....	.....	Parsons
Cities Service Oil Co.	Lake Charles, La.	Fluid Hydro.	17,250 bbls.	.....	Under Constr.	Late Summer, 1954	.....	Kellogg	Kellogg
Cities Service Refg.	Lake Charles	Hydro. Feed Prep.	44,450 bbls.	$2 million	Under Constr.	1954	.....	Kellogg	Kellogg
Cities Service Refg.	Lake Charles	Vacuum Flasher	26,750 bbls.	$2 million	Under Constr.	1954	.....	Kellogg	Kellogg
*Columbian Carbon Co.	North Bend, La.	Carbon Black Plt.	60,000,000 lbs./yr.	.....	Under Constr.	Nov., 1954	.....	.....	.....
*Commercial Solvents Corp.	Sterlington, La.	Nitroparaffins Fac.	.....	$5,000,000 (Incl. Peoria, Ill., Expan.)	Planned	4th Qtr., 1955	.....	Staff	.....
*Commercial Solvents Corp.	Sterlington, La.	Methylamine Fac.	.....	$4,300,000	ODM Approved	.....	.....	.....	.....
*Commercial Solvents Corp.	Sterlington, La.	Ammonia, Methanol, Ammonium Nitrate	Double Ammonia-Methanol	$20,000,000	Under Constr.	Oct., 1954	.....	Staff	Ford, Bacon & Davis
Consolidated Chemical Industries, Inc.	Baytown, Texas	Acid Unit	600 tons	$4,500,000	Under Constr.	Oct., 1954	.....	Chemico	Chemico
*Consolidated Chemical Industries	Houston, Texas	Sulfuric Acid Plt.	.....	$3,500,000	Planned	Dec., 1954	.....	Chemico	Chemico
★ Continental Oil Company	Lake Charles, La.	Nat. Gaso. Plt. Expansion	90 Mmcf	$1,500,000	Completing	.....	.....	Hudson	Hudson
*Corpus Christi Refining Co.	Tucker, Texas	Modernization	.....	.....	Planned	.....	.....	.....	.....
Coden Petroleum	Big Spring, Tex	Avia.-Gaso. Facl.	2,650 bbls.	$2,920,000	Completing	.....	U.O.P.	U.O.P., Treco	Treco
*Crown Central Petroleum Corp.	Houston, Texas	Houdriformer	5,000 bbls.	$1.5 million	Under Constr.	Oct., 1954	Houdry	Houdry	Blaw-Knox
Danaho Refining Co.	Pettus, Texas	TCC Cat Cracker w/Reform.	3,500 bbls.	$2,600,000	Under Constr.	Nov., 1954	Suc.-Vac.	Koch	.....
		Cat Poly.	265 bbls.	.....	.....	.....	.....	.....	.....
		Crude Expansion Gas Conc.	7,500 bbls.	.....	.....	.....	.....	.....	.....
Delta Chemical Co.	Buras, La.	Petrochemical Plt.	70 tons	.....	Planned	.....	.....	.....	.....
Dow Chemical Co.	Freeport, Texas	Ethylene Dibromide	.....	$8.5 million	DPA Certified	.....	.....	.....	.....
Dow Chemical	Freeport, Texas	Styrene Plastics	.....	$1.6 million	Completed	.....	.....	Braun	Braun
Dow Chemical	Freeport, Texas	Benzene Addi.	.....	$1.2 million	Completed	.....	.....	.....	.....
Du Pont	Beaumont, Tex	Methionine Plt.	.....	$4,000,000	Planning	.....	.....	.....	.....
Eastern States Petroleum Co.	Houston, Texas	Coking Plant	13,000 bbls.	$4,000,000	Projected	.....	.....	.....	.....
Eastern States Pet.	Houston, Texas	Ethylene Mfg.	.....	$4 million	Projected	.....	.....	U.O.P.	.....
Eastman Kodak Co.	Longview, Tex.	Polyethylene Plt	20,000,000 lbs./yr.	.....	Projected	.....	.....	.....	.....
Esso Standard	Baton Rouge	Fuel Products Expansion	60,000 bbls.	.....	Under Constr.	3rd Qtr., 1954	.....	S.O.D., Kellogg, Ref. Eng.	Kellogg, Ref. Eng.
Esso Standard	Baton Rouge, La.	Pressed Oil Dist. Unit	5,540 bbls.	.....	Under Constr.	2nd Qtr., 1954	.....	S.O.D., Parsons	Parsons
*Esso Standard	Baton Rouge, La.	Fluid Hydroforming Unit	20,000 bbls.	.....	Announced	1st Qtr., 1955	.....	S.O.D., Braun	Braun
*Ethyl Corp.	Baton Rouge, La.	15% Increase in Anti-Knock Compound Output	.....	.....	Under Constr.	Early, 1955	.....	.....	.....
*Ethyl Corp.	Houston, Texas	15% Increase in Anti-Knock Compound Output	.....	.....	Under Constr.	Early, 1955	.....	.....	.....
D. D. Feldman Co.	Lake Arthur, La.	Petrochem. Plt.	.....	$843,000	Applied for certificate of necessity	.....	.....	.....	.....
*Gulf Oil	Port Arthur, Texas	Platforming	29,000 bbls.	.....	Constr. to Start Spring	1st Qtr., 1955	.....	.....	Fluor
Gulf Oil	Pt. Arthur, Tex	Exp. Ethylene Fac.	660,000 lbs./day	.....	Engineering	1st Qtr., 1955	.....	S&W, Badger Div.	S&W, Badger Div.
★ *Gulf Refining, Humble Oil & Refining, The Texas Co.	St. Landry Parish, La.	Cycling & Gasoline Plt.	.....	$10,000,000	Under Constr.	.....	.....	.....	.....
★ *Gulf Refining	St. Landry Parish, La.	Nat. Gaso. Fac.	.....	$5,000,000	.....	.....	.....	.....	.....
Heyden Chemical & Monsanto Chemical	Texas City, Tex	Methanol Plt.	1,000 bbls.	$8,000,000	Projected	Jan., 1955	.....	.....	.....
Humble O&R Co.	Baytown, Texas	Propane Desphalting Unit	28,000 bbls.	$6,100,000	Completing	.....	.....	Kellogg	Kellogg
Humble O&R Co.	Baytown, Texas	Cat. Poly.	4500 bbls.	$5,400,000	Under Constr.	Sept., 1954	.....	Hydrocarbon	Hydrocarbon
Humble O&R Co.	Baytown, Texas	Pipe Still (crude)	75,000 bbls.	$6,500,000	Under Constr.	July, 1954	.....	Foster Wheeler	Foster Wheeler
Humble & Consolidated Chemical Industries, Inc.	Baytown, Texas	Sulfuric Acid	.....	.....	Under Constr.	Oct., 1954	.....	.....	.....
Ingram Products	Mereaux, La.	Refinery Modernization	8,000 bbls.	$2,500,000	Complete	.....	U.O.P.	Procon	Procon
★ Jergins Oil Co. of Texas	Dewitt, Texas	Comp. Stripper Plt.	.....	.....	Authorized	.....	.....	.....	.....
★ Kerr-McGee Industries, Inc.	Pampa, Texas	Additional Fac. Nat. Gas Plt.	25 Mmcf	$520,000	Under Constr.	July, 1954	.....	Kerr-McGee, J. E. Carlson, Inc.	J. E. Carlson, Inc.
★ Kerr-McGee Industries, Inc.	Pampa, Texas	Offsite Fac.	.....	$30,000	Planning	July, 1954	.....	Kerr-McGee	.....
Kolker Chemical Works, Inc.	Houston	Lindane	.....	$1 million	Planning	.....	.....	.....	.....
*Koppers Co.	Site Undetermined	Polyethylene Plt.	.....	.....	Engineering	Mid 1955	.....	Koppers	Koppers
Magnolia Petroleum	Beaumont, Tex.	Therm. Cat. Reforming	17,000 bbls.	$10 million	Under Constr.	Late, 1954	Suc.-Vac.	.....	Lummus

★ Natural gasoline plants under construction or expansion.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
*McBride Refining Co.	Port Brownsville, Texas	Ref. Expan.	†12,500 bbls.	$2,500,000	Planned				
McMurrey Refg. Co.	Tyler, Texas	Pet. Refining		$70,000	DPA Certified				
Monsanto	Texas City, Tex.	Vinyl Chloride		$7.3 million	Announced				
Monsanto Chemical	Texas City, Tex.	Polyethylene Plt.	66,000,000 lbs./yr.		Under Constr.				
Onyx Refining Co.	Abilene, Texas	Expansion	†500 bbls	$900,000	Planned				
*Pan American Refining Corp.	Texas City, Texas	Methyl Mercaptan Plt.	5 million lbs./yr.		Projected	End, 1954			Rust
Pan American Ref.	Texas City, Tex.	Ultraforming	21,200 bbls.		Under Constr.				Kellogg
r *Payne & Johnston, & B. G. Byars	Nolan County, Texas	Nat. Gaso. Plt.	8-10 Mmcf		Under Constr.				
*Petrocarbon Chemicals, Inc.	Irving, Texas	Houdiforming Unit	1,000 bbls.		Under Constr.	Mid 1954	Houdry	Texas	Texas
Petrolite Corp.	Sweeny, Texas	Pet. Ref.		$25,899	DPA Certified				
Petrolite	Destrehan, La.	Pet. Ref.		$60,000	DPA Certified				
Phillips Chemical Co.	Borger, Texas	Carbon Black	36,000 lbs.		Under Constr.	July, 1954		Phillips	Roman-Chase
Phillips Pet. Co.	Sweeny, Texas	UOP Platformer	16,000 bbls.		Under Constr.	Nov., 1954	U.O.P.	Procon	Procon
* Phillips Petroleum Co.	Fullerton, Texas	Installation for Gas Injection			Under Constr.	June, 1954		Phillips	Phillips
Pontiac Refining	Corpus Christi	Av-Gas Expan.		$2 million	PAD Certified				
Premier Petroleum	Ft. Worth, Tex.	Refinery Expan.		$3.6 million	DPA Certified				
Premier Petroleum	Ft. Worth, Tex.	Cat. Crker.	2,800 bbls.	$2,100,000	Complete		U.O.P.	U.O.P.	Ref. Eng.
Premier Pet. Co.	Longview, Tex.	Cat. Poly. Plt.			Under Constr.				
		Glycerine Plant Extension			Under Constr.	3rd Qtr., 1954		Pioneer	Pioneer
* Reef Fields Gas Corp.	Howard City, Texas	Gaso. Plt. Exc.	17,500 gals. of isobutane	$274,830	Completing			Delta	Delta
Shell Chemical Corp.	Houston, Texas	Glycerine Plt. Extension			Under Constr.	3rd Qtr., 1954		Pioneer	Pioneer
Shell Chemical Corp.	Norco, La.	Chlorohydrins for Glycerine & Epon Resins			Under Constr.	4th Qtr., 1954		Fluor	Fluor
Shell Oil Co.	Deer Park, Tex.	Pet. Ref.		$300,000	Completed				
Shell Oil	Norco, La.	Expansion	†25,000 bpd.	$41 million	Under Constr.	3rd Qtr., 1954			Pritchard, Foster Wheeler, McKee
Shell Oil	Houston, Texas	Av-Gas Components		$1 million	Completed				
*Sinclair Refining Co.	Houston, Texas	Sulfur Recov. Plt			Planned			Parsons	Parsons
Spencer Chemical	Orange, Texas	Polyethylene Plt.	45,000,000 lbs./yr.	$15,000,000	Under Constr.	Spring, 1955	I.C.I. of England	Staff, Hedrick Engineering	Quaker Valley Constr.
* Stanolind Oil & G.	Pettus, Texas	Sales Gas Fac.	12.5 Mmcf		Complete			Staff	Ref. Eng.
* Stanolind Oil & G.	Oakville, Texas	Gas Injection	25 Mmcf		Under Constr.	2nd Qtr., 1954		Staff	
* Stanolind Oil & Gas Co.	Midland Farms Field, Andrews County, Texas	Compression Gasoline Plant	10 Mmcf		Considered	June, 1954			Anderson-Baird
* Stonewall Gas Products	Aspermont, Texas	Nat. Gas Process		$1,500,000	Under Constr.	June, 1954		Stonewall	Vaughn & Taylor Bowdin Constr. Co.
* Sunray Oil Co.	Snyder, Texas	Gaso. Plt. Ext.		$1,500,000	Under Constr.	2nd Qtr., 1954		Fluor	Fluor
* Sunray Oil	Sarepta, La.	Cycling & Gasoline Plant	12 Mmcf.	$1,300,000	Under Constr.	2nd Qtr., 1954		Born Engr.	Born Engr.
*Suntide Refining Co.	Corpus Christi, Texas	Alkyl. Expan.	To 70,000 bbls.		Projected				
* Tennessee Production Co.	Aqua Dulce, Texas	Gasoline Plt.	100 Mmcf	$2.5 million	Completed			Olsen	Olsen
Texas Eastman Co.	Longview, Texas	Syn. Hard Wax Plt.		$7,000,000	Under Constr.				
Texas Eastman	Longview, Tex.	Petrochemicals	20,000 bbls. Propane	$5.7 million	Partial Oper.				
The Texas Co.	Port Arthur, Texas	No. 1 Catalytic Reformer	20,000 bbls.		Under Constr.	2nd Qtr., 1954		U.O.P. & Others	Procon & Others
*The Texas Co.	Port Arthur, Tex.	No. 2 Cat. Reformer	20,000 bbls.		Under Constr.	2nd Qtr., 1955			
The Texas Co.	Amarillo, Texas	Expan. & Mod. Cat. Cracker Co. Reform. Atmos. Crude Pipe Still, Delayed Coker, Alky. Unit, Cat. Poly., Treating & LPG Handling Fac.	†7,500 bbls.		Under Constr.	4th Qtr., 1954		Kellogg, U.O.P. & Others	Kellogg & Others
The Texas Co.	El Paso, Texas	Expan. & Mod. Atmos. Crude Pipe Still, Cat. Reform., Cat. Cracker, Delayed Coker, Cat. Poly., Treating & LPG Handling Fac.	†5,400 bbls.		Under Constr.	4th Qtr., 1954		Foster Wheeler, U.O.P., Others	Foster Wheeler & Others
* *Texas Pacific Coal & Oil Co.	Hamlin, Texas	Nat. Gaso. Plt.	5 Mmcf	$800,000	Planned				
Thiochemicals, Inc.	Pt. Arthur, Tex.	Methyl Mercaptan Synthesis		$500,000	Completing			Pringle, Dukler & Crump	
United Carbon Co.	Shamrock, Texas	Carbon Black	68,500 lbs.	$1.5 million	Under Constr.				
*United Chemical Co.	Timpson, Texas	Ammonia & Urea Plt.	100 tons Urea; 250 tons Ammonia		Projected	Late, 1955			Foster Wheeler
Warren Petroleum Corp.	Conroe, Texas	Pentaerythritol, Acetaldehyde & Alcohols Plant			Under Const.	June, 1954		Staff	O. L. Olsen
Wickett Refining	Wickett, Texas	Thermal Crker	2,000 bbls.		Under Constr.				
ROCKY MOUNTAIN									
Allied Chemical & Dye Corp.	La Platte, Nebr.	Fertilizer			Under Constr.	May, 1954		Girdler	Catalytic Constr.
* Atlantic Refining Co.	Lovington, N.M.	Natural Gas	25 Mmcf.		Projected				
Carter Oil Co.	Billings, Mont.	Fluid Cat Cracker Expansion	15,000 bbls.		Under Constr.	Late 1954		Staff	Braun
Continental Sulphur & Phosphate Corp.	Thermopolis, Wyoming	Sulfur Extraction	50 Tons/Yr.		Under Constr.		American Sulfur & Refining		Chemico
* *Cullen Group	Newcastle, Wyo.	Gas Plt.		$4,500,000	Planned				
*First National Petroleum Corp.	Jensen, Utah	Ref. Expan.	to 3,000 bbls.		Planned				

* Natural gasoline plants under construction or expansion.

● Continued on page 205

Those MARLEY fans sure move a lot of air!

...and they will keep on doing it!

... that's because Marley multi-blade aluminum fans are engineered specially for cooling tower application—specifically, for Marley cooling towers. The true air foil blade design, based on years of research and wind tunnel testing, was selected as the most efficient for the range in air velocities and pressures found in various types of cooling towers. The twist and taper of the wide, sturdy blade is designed to provide constant velocity from hub to tip. By using six to twelve blades, depending upon fan diameter, Marley fans operate more smoothly and quietly.

Another reason Marley fans move a lot of air is that they operate in Marley Laminated Fan Cylinders, developed to complement the performance of this particular fan. Marley fans, air delivery cylinders and Geareducers are engineered as complete functional units, assuring the balance necessary to attain top fan efficiency.

Durability and strength are important, too. These are achieved by utilizing the newest casting techniques and an aluminum alloy selected for its castability, strength and corrosion resistance. Every dimension from shank to tip is more than ample for any operating load encountered.

For further details write for Bulletin No. CF-54 or contact your nearest Marley representative in any of fifty major cities.

Founder Member
Cooling Tower Institute

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Kansas City, Missouri

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diethylene glycol | *for sweetening natural and refinery gas*
for dehydrating natural gas

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Diethylene Glycol
Monoethanolamine
Diethanolamine
Triethanolamine
Nonyl Phenol
Morpholine
Ethylene Carbonate
Propylene Carbonate
Polyethylene Glycols
Glycol Ethers

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
★ General Pet. Corp.	Worland, Wyo.	Gasoline Ext. & Sulfur Recov.	8 Mmcf	$4 million	Under Constr.	.....	.....	Fluor	.....
*Jefferson Lake Sulphur Co.	Manderson, Wyo.	Sulfur Recov. Plt.	111 tons	$600,000	Authorized	Autumn, 1954	.....	.....	Parsons
Oriental Refining Co.	Denver, Colo.	Perco Cyclover-sion Unit	1,500 bbls.	.....	Under Constr.	.....	.....	.....	.....
Phillips Chem.	Eunice, N.M.	Sulfur Extrac.	100 tons	$1.5 million	Contracted	.....	.....	.....	.....
★ Phillips Petroleum	Lea City, N.M.	Natural Gasoline	.....	$27,150	PAD Certified	.....	.....	.....	.....
Phillips Petroleum	Great Falls, Montana	Refining	.....	$3 million	Certified DPA	.....	.....	.....	.....
Phillips Petroleum Co.	Woods Cross, Utah	Expansion	.....	.....	Projected	.....	.....	.....	.....
Proven Oil & Refining	Florence, Ariz.	Refinery	15,000 bbls.	$18.3 million	Under Constr.	1955	.....	Ebasco and Lummus	.....
*Salt Lake Chemical Co.	Salt Lake City, Utah	Synthetic Ammonia Plt.	120 tons of Ammonia, 30 tons dry ice	$7,800,000	Under Constr.	3rd Qtr., 1955	.....	Tears	Tears, Henry C. Beck Co.
★ Skelly Oil Co.	Eunice, N.M.	Plt. Expansion	†20 Mmcf	.....	Completing	.....	.....	Skelly	J. E. Carlson
★ *Shell Oil Co.	Mt. Hope, Colo.	Gas Compression Plt.	4.5 Mmcf	$650,000	Planned	.....	.....	.....	Blaw-Knox
★ Socony-Vacuum Oil Co., et al	Manderson, Wyo.	Gas Processing Plt.	.....	$15,000,000	Under Constr.	Nov., 1954	.....	.....	.....
Standard Oil (Ind.)	Casper, Wyo.	Alkylation Unit	575 bbls.	.....	Under Constr.	Mid 1954	.....	Graver	Graver
*Standard Oil (Ind.)	Casper, Wyo.	Ultraformer	3,375 bbls.	.....	Design	Early, 1955	.....	.....	.....
Sullivan Mining Co.	Kellogg, Idaho	Sulfuric Acid Plt	300 tons	$4,000,000	Under Constr.	June, 1954	.....	Stearns-Rodger, Leonard Constr	Stearns-Rodger, Leonard Constr.
Sure-Seal Corp.	Salt Lake City	Wax Refinery	.....	$2,000,000	Completed	.....	.....	.....	.....
Utah Chemical Co.	Sanpete Valley, Utah	Ammonia Plt.	278 tons	$18,800,000	Planned	.....	.....	.....	Cat. Constr.
★ Warren Petroleum	Lea Co., N.M.	Nat. Gaso. Plt.	22 Mmcf	.....	Complete	.....	.....	Fluor	Fluor
Western States Refg.	Salt Lake City	Topping; Crker.	3,000/2,200 bbls	$1.1 million	.....	.....	.....	.....	.....
WEST COAST									
*Brea Chemicals, Inc.	Brea, Calif.	Nitric Acid & Ammonium Nitrate Plt.	.....	$2,500,000	Engineering Contract Awarded	.....	.....	Braun	.....
*Brea Chemicals, Inc	Brea, Calif.	Dry Ice Plt.	70 tons	$750,000	Under Constr	June, 1954	.....	Braun	Braun
Brea Chemicals	Brea, Calif.	Ammonia Plt.	235 tons	$13,000,000	Completing	.....	.....	Braun	Braun
*Calstate Ref. Co.	Signal Hill, Calif.	Hyperformer Unit	1,100 bbls.	$300,000	Under Constr	.....	Union Oil	.....	Calstate
*Caminol	Hanford, Calif.	Petroleum Refining Fac.	.....	$1,600,000	ODM Approved	.....	.....	.....	.....
Caminol	Hanford, Calif.	Poly. Plt.	150 bbls.	$120,000	Completed	.....	U.O.P.	U.O.P.	Caminol
Carbide & Carbon Chemicals Company	Torrance, Calif.	Polyethylene Plt	60 million lbs./yr.	$36 million	Under Constr.	End, 1954	.....	.....	.....
Commercial Solvents Corp.	Agnew, Calif.	Pentaerythritol	.....	.....	Completing	.....	.....	Staff	Staff
Douglas Oil Co.	Bakersfield, Calif Calif.	Cat. Reforming Unit	2,500 bbls.	$500,000	Complete	.....	Atlantic	.....	Parsons
Eureka Refining	Long Beach, Cal	Cat. Crker.	6,000 bbls.	$2.2 million	.....	.....	.....	.....	.....
General Petroleum	Torrance, Calif.	Therm. Cat. Reform.	19,000 bbls.	$9 million	Under Constr.	Fall, 1954	.....	Soc-Vac., Bechtel	Bechtel
General Pet. Corp.	Ferndale, Wash.	Refinery	35,000 bbls.	$35 million	Under Constr.	August, 1954	.....	Bechtel	Bechtel
General Petroleum	Torrance, Calif.	Depropanizer	.....	$350,000	Engineering	Fall, 1954	.....	E&A	E&A
Hancock Oil Co.	Long Beach, Calif.	Cat. Crker. & Facilities	4,200 bbls.	$3,500,000	Engineering	Dec., 1954	Soc-Vac	.....	.....
*Hancock Oil Co.	Long Beach, Calif.	Cat. Poly.	500 bbls.	.....	Under Constr.	.....	U.O.P.	.....	.....
Mohawk Petroleum	Bakersfield, Calif.	Cat. Reformer	2,500 bbls.	$600,000	Under Constr.	.....	.....	.....	Parsons
Pacific Oil & Refining Co.	Puget Sound, Wash.	Refinery	10,000 bbls.	.....	Projected	.....	.....	.....	.....
Richfield Oil	Watson, Calif.	Expansion; Cat Cracker; Aromatics	20,000 bbls.	$43 million	Under Constr.	1954	.....	Braun	Fluor
Richfield Oil	Los Angeles	Ref Expan.	†20,000 bbls.	$40 million	Under Constr.	Aug., 1954	.....	.....	Fluor
Rothschild Oil	Santa Fe Springs, Calif.	Cat. Cracker	6,000 bbls.	$2 million	.....	.....	.....	.....	Braun
Shell Oil	Anacortes, Wash.	Refinery	50,000 bbls.	$75,000,000	Under Constr. Mid 1954	End, 1955	.....	Bechtel	Bechtel
Shell Oil	Martinez, Calif.	Platform. Unit	4,500 bbls.	$2,300,000	Under Constr.	June, 1954	U.O.P.	U.O.P.	Braun
*Shell Oil Co.	Brea, Calif.	Cap. Increase	†16 Mmcf	$600,000	Under Constr.	.....	.....	.....	J. B. Gill Co.
★ Signal Oil & Gas	Los Angeles, Calif.	Butanes-Iso-butane	.....	$500,000	.....	.....	.....	.....	.....
Standard (Calif.)	Richmond, Calif.	Cat. Reformer	20,000 bbl.	$20,000,000	Planning	July, 1955	.....	.....	.....
	El Segundo, Calif.	Cat. Reformer	20,000 bbl.						
Standard (Calif)	El Segundo, Cal	Cat Cracker	36,000 bbls.		Under Constr.	Aug., 1954	.....	Fluor	Fluor
		Offsite Fac.		$20,000,000	Under Constr.	Aug., 1954	.....	Fluor	Macco
		Alkylation			Under Constr.	Aug., 1954	.....	.....	.....
		Reniduum Stripper	52,000 bbls.		Complete	.....	.....	Kellogg	Kellogg
Stauffer Chemical	Compton, Calif.	Sulfuric Acid	.....	$57,070	Engineering	.....	.....	.....	.....
Stauffer Chemical	Richmond, Calif.	Sulfuric Acid	.....	$283,500	.....	.....	.....	.....	.....
★ The Texas Company	Los Angeles, Calif.	Gaso. Plt.	18 Mmcf	.....	Completing	.....	.....	.....	OEFCO Constr. Co.
*The Texas Co.	Wilmington, Calif.	Platforming	10,000 bbls.	.....	Under Constr.	2nd Qtr., 1955	.....	.....	.....
*The Texas Co.	Wilmington, Calif.	Hydrotreating	10,000 bbls.	.....	Under Constr.	2nd Qtr., 1955	.....	.....	.....
*The Texas Co.	Wilmington, Calif.	Isomerization	1,000 bbls.	.....	Under Constr.	2nd Qtr., 1955	.....	.....	.....
*Tide Water Associated Oil	Avon, Calif.	Hydrobon-Platformer	10,000 bbls.	.....	Under Constr.	Dec., 1954	U.O.P.	Braun	Braun
Union Oil (Calif.)	Willbridge, Ore.	Lub. Oil Blending Plt.	.....	$450,000	Under Constr.	2nd Qtr., 1954	.....	Staff, Sweet	.....
Union Oil (Calif.)	Santa Maria, Calif.	Coking Plt.	.....	.....	Site Purchased	.....	.....	.....	.....
Union Oil (Calif.)	Cut Bank, Mont.	Cat. Reform.	$600,000	.....	Engineering & Material Ordering	Sept., 1954	Atlantic	Parsons	Parsons
*Union Oil (Calif.)	Oleum, Calif.	Unifining Unit & Auxiliary Fac.	15,750 bbls.		Engineering	Dec., 1954	Union Oil	Braun	Braun
*Union Oil (Calif.)	Oleum, Calif.	Site Work and General Fac. for Unifiner & Platformer		$14,900,000	Engineering	Nov., 1954		Bechtel	Bechtel
*Union Oil (Calif.)	Oleum, Calif.	Platformer and Auxiliary Fac.	14,500 bbls.	.....	Engineering	Nov., 1954	U.O.P.	Braun	Braun

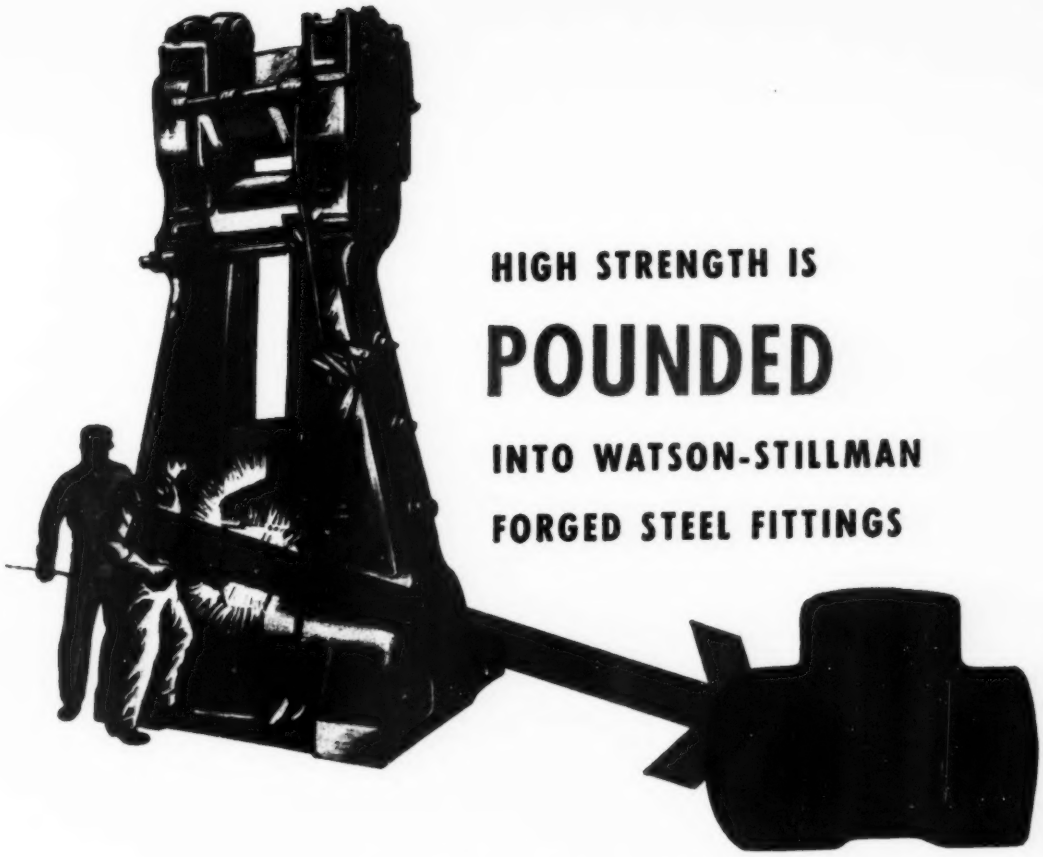
★ Natural gasoline plants under construction or expansion.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
*Union Oil (Calif.)	Oleum, Calif.	Increase Grease Mfg. Cap.		$600,000	Material Ordering	Oct., 1954		Bechtel	Bechtel
Union Oil (Calif.)	Los Angeles Calif.	Rebuild Isomer. Plt.		$1,300,000	Under Constr.	July, 1954		Parsons	Parsons
FOREIGN									
Canada									
British American Oil Company	Clarkson, Ontario	Ref. Additions & Fld. Cat. Crker.	11,600 bbls.	$8 million	Under Constr.	May, 1954	Kellogg	Canadian Kellogg & Barnes	Canadian Kellogg & Barnes
★ Campbell Absorption Plant, Ltd.	Alberta, Canada	Natural Gaso. Plt.			Planned				
*Canadian Industries, Ltd.	Edmonton, Alberta	Expan. of Polyethylene Plt.	16 million lbs./yr.			End, 1954			
Canadian Petrofina Ltd.	Montreal, Quebec, Canada	Refinery, Houdriflow Cat Cracker, Cat Poly Dist. Unit., Vacuum Dist. Cat. Reformer, Auxiliary, Fac., Hydrodesulfurization	20,000 bbls.	$20,000,000	Projected	Late 1955	Houdry		Kellogg, Lummus
Canada Southern Oils	Saskatchewan	Refinery	10-20,000 bbls.	$7,000,000-$10,000,000					
Consumer's Co-Op. Ref.	Regina, Saskatchewan	Mod. & Expan. Cat. Crker, Poly Gas & Vac. Units	11,000 bbls.	$5,500,000 $8,000,000	Completing		U.O.P.	U.O.P.	Ref. Eng.
*Dow Chemical of Canada	Sarnia, Ontario, Canada	Ammonia Plt. Expan.		$3,000,000	Under Constr.	1954		Fluor Accociate	Fluor of Canada
Hooker Chemicals, Ltd	N. Vancouver, B. C.	Chemicals			Projected				
Imperial Chemical Industries of Canada	Milhaven, Ont.	Terylene Fibre	11,000,000 lbs./yr.	$20,000,000	Under Constr.	Mid 1955		Ferguson	Ferguson
Imperial Oil	Sarnia, Ontario	Quality Control Lab. Packaging & Shipping Plt and Mech. Shops		$6,000,000	Under Constr.	1954			CanadianBechtel
Imperial Oil	Edmonton, Alberta	Lube Oil Plt.	2,000 bbls.	$10,000,000	Under Constr.	Mid 1955		Staff	
Imperial Oil	Regina, Sask.	Mod & Expan.	12,500 bbls.	$7 million	Completing			Staff	Fluor
Imperial Oil, Ltd.	Montreal, Quebec	25% Cap. Increase	12,000 bbls.	$10,000,000	Under Constr.	Early, 1955		Staff	Canadian Bechtel
*Imperial Oil, Ltd.	Imperoyal, Canada (near Halifax)	Rebuild Existing Plt, including Fluid Cat. Cracker	41,625 bbls. 27,000 bbls.	$25 to $30 mil.	Constr. to start Early 1955	Summer, 1956			
Kendall Ref. of Canada	Toronto, Canada	Lub. Oil Compounding, packaging & Distrib. Plt.			Considering	Summer, 1956			
★ Leduc Southern Absorption, Ltd.	Edmonton, Canada	Gas Absorption Plt.		$20,000,000	Permit Granted				
McCall Frontenac Oil Co.	Edmonton, Alberta	Capacity Increase to	11,000 lbs.	$4,000,000	Planned	Early 1955			
*McCall-Frontenac Oil Co.	Edmonton, Alberta	Thermal Cracking Unit	3,000 bbls.		Planned				
Midland Pet. & Pacific Pet.	Stettler, Alta.	Crude Refinery	4,000 bbls.	$2 million	Under Constr.				
North Star Oil, Ltd	St. Boniface, Manitoba	Modernization, Cat. Cracker	8,000 bbls.	$5-6,000,000	Engineering	1955	U.O.P.	U.O.P.	
Panther Oil & Grease Mfg. Co. of Canada, Ltd.	Leaside, Ontario	Mfg. Cold Process Liquid Roof Coating	4,500 gals.		Projected				
		Mfg. Grease	10,000 lbs.		Projected				
		Blending Oils	2,000 gals.		Projected				
Royalite Oil Co.	Kamloops, B.C.	Refinery	5,600 bbls.		Under Constr.	Nov., 1954	U.O.P.		
*Royalite Oil Co.	Kamloops, B.C.	Fluid Cat Crker., Poly & Gas Concentration	1,425 bbls.	$2,500,000	Engineering	Mar., 1955	U.O.P.	U.O.P., Caribou Eng. Co.	Caribou Eng. Co.
		Crude Unit-Atmos. & Vacuum	5,000 bbls.	$2,500,000	Completed			Caribou Eng. Co.	Caribou Eng. Co.
Shell Oil Co. of Canada	Okotoks, Canada	Sulfur Ext. Plt.			Planned				
★ *Shell Oil Co. of Canada, Ltd.	Jumping Pound, Alberta, Canada	Gas Plt. Expan.	130 Mmcf	$1,500,000	Under Constr.	Oct., 1954			Ref. Eng.
*Shell Oil of Canada	Calgary, Alberta, Canada	Sulfur Plt. Cap. Increase	155 tons		Planning				
*Standard Oil Company of British Columbia	Burnaby, B.C.	Refinery Cat. Cracker	11,000 bbls. 2,750 bbls.	$10,000,000	Under Constr.	4th Qtr., 1954			Fluor
Supreme Refineries	Ogden, Alta.	Asphalt Plt.			Planning				
★ Texaco Oil Co.	Edmonton, Canada	Gas Absorp. Plt.		$6,000,000	Under Constr.				
*Wainwright Producers & Refiners, Ltd	Edmonton, Alberta, Canada	Capacity, Inc.	12,300 bbls.		Planned			Ref. Eng.	
Wainwright Refineries, Ltd.	Wainwright, Alberta	Dehydrating & Desalt'g Equip.	650 bbls.	$30,000	Completing				Petreco
Latin America									
Brasilian Govt.	Sao Mateus (Santo) Brazil	Shale Oil Pilot Plt.	100 bpd.	$500,000					
Brasilian Investments	Niteroy, Rde J. Brazil	Refinery	30,000 bbls.		Petitioned				Kellogg
CaribbeanRefiningCo.	San Juan, Puerto Rico	Refinery	10,000 bbls.	$11,000,000	Under Constr.	1st Qtr., 1955	U.O.P.	Fluor	Fluor
Colombia Gov.	Undecided	Refinery	25,000 bbls.		Proposed				
Colombian Petro-Company	Barco Concession	Gas Treating Plt.	2,000 bbls.	$5 million	Under Constr.				
★ Colombian Petroleum	Tibu, Colombia	Gasoline Plt. Crude Stabiliser	60 Mmcf 10,000 bbls.		Completed			Fluor	Fluor

★ Natural gasoline plants under construction or expansion.

● Continued on page 209



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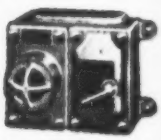

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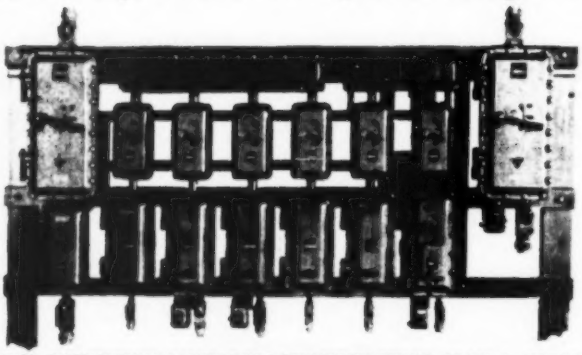
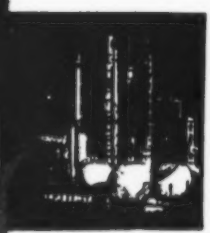
CIRCUIT BREAKERS

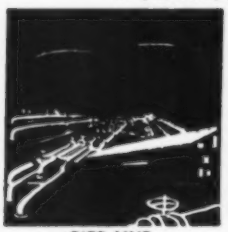
SEALING FITTINGS



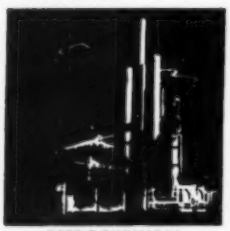
POWER DISTRIBUTION PANELBOARD EXPLOSION-PROOF, CLASS I, GROUP D
For products pipe line stations.



REFINERY



PIPE LINE



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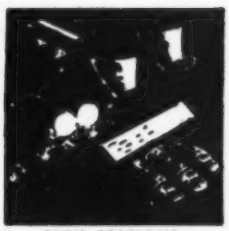
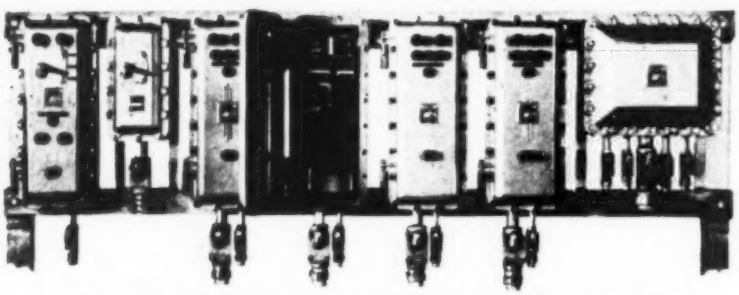


BULK STATIONS



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REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Companhia de Petroleo da Amasonia	Amazonas State, Brazil	Refinery	5,000 bbls.	.....	Studies	.....	.....	.....	.....
*Conselho Nacional do Petroleo	Tremembe, Sao Paulo, Brazil	Shale Oil Plt.	10,000 bbls.	.....	Contracted	.....	.....	Foster Wheeler	Foster Wheeler
Conselho Nacional do Petroleo	Cubatao, Sao Paulo, Brazil	Therm. Crk. Ref. Reforming, Vis Breaking Cat. Poly.	45,000 bbls.	$60,000,000	Under Constr.	Mid 1954	Hydrocarbon Calif. Res., Shell Dev., Edeleanu	PA Hydro Res.	PA Hydro Res. and McKee
Conselho Nacional do Petroleo	Bahia, Brazil	Lube Oil Fac.	2,000 bbls.	$12,000,000	Planned	.....	.....	.....	.....
		Expansion	10,000 bbls.						
Conselho Nacional do Petroleo	Sao Paulo State	Refinery	30,000 bbls.	.....	Studies	.....	.....	.....	.....
Corporacion de Fomento (ENAP)	Concon, Valparaiso, Chile	Refinery	20,000 bbls.	$12,000,000	Under Constr.	Sept., 1954	.....	Kellogg	Kellogg Pan American
Creole Pet. Corp	Amuay Bay, Estado Falcon, Venezuela	Atmospheric Pipestill	70,000 bbls.	$44,000,000	Engineering	End 1954	.....	Foster Wheeler	Foster Wheeler
Creole Petroleum Corp.	Amuay	Fluid Hydroformer	10,000 bbls.	.....	Engineering	April, 1955	S.O.D.	S.O.D.	.....
N. V. Curacaosche Petroleum	Curacao, Netherlands Antilles	Lube Ref. Ext.	2,000 bbls.	.....	Complete	.....	.....	.....	.....
Diadema Argentina	Buenos Aires	Luboil Refining	600 bbls.	.....	Under Constr.	1954	.....	.....	.....
Empresa Nacional de Petroleo	Concon, Chile	Refinery	20,000 bbls.	$8,000,000	Under Constr.	1954	.....	P.A., Kellogg	P.A., Kellogg
Empresa Colombiana de Petroleos	Barrancabermeja, Colombia	Topping Unit	30,000 bbls.						
		Fluid Cat. Crk. Model IV	15,130 bbls.	$30,000,000	Under Constr.	July, 1954	Standard Oil	Foster Wheeler	Foster Wheeler
		Sulfuric Acid Alky. Unit and Offsite Fac.	1,600 bbls. Avgas						
*Helios, S.A.....	San Andres, Peru	Lube Oil; Asphalt Refinery	60,000 tons lube oil; 10,000 tons Asphalt/yr.	$8,000,000	Projected	Early 1956	.....	Hydrocarbon	.....
*International Petroleum Company (Colombia)	Cartagena, Colombia	Refinery	25,000 bbls.	$35,000,000	Planned	1957	.....	.....	.....
International Petroleum (Colombia)	Barrancabermeja, Colombia	Refinery Modernization	35,000 bbls.	$20-25 million	Under Constr.	Late 1954	.....	Foster Wheeler	Foster Wheeler
Petroleos Mexicanos	Tamaulipas, Ciudad Madero, Mex.	Enlarge Refinery Capacity	47,250 bbls.	$22,000,000	Projected	.....	.....	.....	.....
Petroleos Mexicanos	Tamaulipas, Arbol Grande Pet., Mex.	Enlarge Refinery	16,800 bbls.	.....	Projected	1954	.....	.....	Staff
Petroleos Mexicanos	Mata Redonda, Vera Cruz, Mex	Improvements	.....	.....	Projected	1954	.....	.....	Staff
Petroleos Mexicanos	Poza Rica, Mex	Expansion	†100 Mmcf	$3.6 million	Under Constr.	1954	.....	McKee	McKee
Petroleos Mexicanos	Reynosa, Mex.	Expansion	5,000 bbls.	.....	Project	1954	.....	.....	Staff
Petroleos Mexicanos	Salamanca, Mex	Lube Oil and Paraffin Plt.	2,200 bbls. Lube 143,000 lbs. Wax	$25,500,000	Under Constr.	Mid 1954	Texaco	McKee	Staff
★ Petroleos Mexicanos	Poza Rica, Vev.	Expan. Gas Absorption Purificating; Sulfur Mfg.	120 Mmcf	$20,000,000	Under Constr.	1954	.....	McKee	Staff
Petroleos Mexicanos	Mexico, D.F.	Cap. Increase	30,000 bbls.	$7,000,000	Projected	1954	.....	.....	.....
Petroleos Mexicanos	Tampico, Tamps	Crude Oil Refinery Mod., Vac. Dist., Cat. Crker. & Related Fac.	75,000 bbls.	$33,000,000	Projected	1954	.....	.....	.....
Petroleos Mexicanos.	Minatitlan, Vev	Expansion: Topping Unit, Feed Preparation Fractionation, Gas Concentration, Poly. Unit, Offsite Fac., Cat Cracker	8,000 bbls.	$3,700,000	Contract let	1954	.....	.....	Fluor
Private Group	Rio de Janeiro	Refinery	20,000 bbls.	.....	Projected	.....	.....	.....	Kellogg
Puerto Rican Oil Refining Co.	Near Ponce, Puerto Rico	Refinery	25,000 bbls.	$20 million	Projected	.....	Undetermined	Parsons, Brinckerhoff, Hall and Macdonald	.....
Refinaria de Manguinhos S.A.	Rio de Janeiro, Brazil	Therm Crk. Vis Breaking	10,000 bbls.	$12,000,000	Under Constr.	End 1954	Edeleanu	Kellogg PA	Kellogg PA
Rafinaria de Petroleos de Manguinhos S.A	Manguinhos, Brazil	Refinery	10,000 bbls.	$10 million	Contracted	1954	.....	Kellogg	Kellogg
Refinaria de Petroleo UNIAO	Capuava Sao Paulo, Brazil	Cat. Crk. TCC Cat Poly.	20,000 bbls.	$15,000,000	Under Constr.	End 1954	Soc. Vac. St. Calif.	PA Hydrocarbon	P.A. Hydrocarbon
Refinaria e Exploracoa de Petroleo "Uniao" S.A.	Capuava, Sao Paulo, Brazil	TCC Recovery Cat. Poly.	20,000 bbls.	.....	Under Constr.	1954	Hydrocarbon Calif. Res., So-Vac.	Hydrocarbon	Hydrocarbon
Refinaria Ipiranga S.A.	Rio Grande, R. G., Brazil	Ther. Crk.	5,000 bbls.	.....	Test runs	.....	.....	Foster Wheeler	Foster Wheeler
Reunidas F Materazzo	Sao Paulo, Brazil	Contact Sulfur Acid Plt.	60 tons	.....	Ordered	.....	.....	.....	Chemico
Richmond Exploration Company	Bajo Grande, Venezuela	New Refinery	35,000 bbls.	.....	Referred	.....	.....	.....	.....
Trinidad Leaseholds, Ltd.	Trinidad	Refinery Addition	.....	$300,000	Designing	.....	.....	H.W.P.	H.W.P.
Yacimientos Petroliferos Fiscales	Eva Peron, Argentina	Refinery	28,300 bbls.	.....	.....	.....	.....	Kellogg	Kellogg
*Yacimientos Petroliferos Fiscales (ENDE)	Eva Peron, Argentina	Integrated Dist.	31,000 bbls.	.....	Under Constr.	1954	Kellogg	Kellogg, Y.P.F.	Y.P.F.
*Yacimientos Petroliferos Fiscales (ENDE)	Luian de Cuyo Mendoza, Argentina	Dist. Expan.	8,300 bbls.	.....	Under Constr.	1954	.....	Y.P.F.	Y.P.F.
*Yacimientos Petroliferos Fiscales (ENDE)	Cerro Batidera P. Huincul Neuquen, Argentina	Dehydration Plt.	10,400 bbls.	.....	Under Constr.	1955	.....	Y.P.F.	Y.P.F.
Europe and Africa									
Albatros S.A. Pour le Raffinage de Petrole	Antwerp, Belgium	Houdriflow Cat. Crker	4,000 bbls.	.....	Under Constr.	.....	Houdry	H.W.P.	H.W.P.
Albatros S.A. Pour le Raffinage de Petrole	Antwerp, Belgium	Expansion	12,000 bbls.	.....	Under Constr.	1954	.....	Petrocarbon, Ltd.	Petrocarbon, Ltd.

★ Natural gasoline plants under construction or expansion.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Anglo-Iranian Oil	Kent, England	Acid/Soda Treat	2,100 bbls.		Under Constr.				
Anglo-Iranian Oil	Kent, England	Propane Deasph.	4,500 bbls.		Completed			Kellogg	Kellogg
Anglo-Iranian Oil	Kent, England	Furfural Extrac.	5,800 bbls.		Under Constr.		Texaco	Lummus	Lummus
Anglo-Iranian Oil	Kent, England	Platformer	6,000 bbls.		Engineering		U.O.P.	E. B. Badger, Ltd.	E. B. Badger, Ltd.
Anglo-Iranian Oil	Kent, England	Vacuum Unit	17,000 bbls.		Under Constr.			E.B.Badger, Ltd.	E.B.Badger, Ltd.
Anglo-Iranian Oil	Schindler, Germany	Furfural Trtg. Plt.			Under Constr.	June, 1954			
Anglo-Transvaal Consolidated Investment Co.	Vall River, Union of South Africa	Synthetic Gasoline and Diesel Oil Plt.		$50-60 million	Contracted			Hydro. Res.	
Aquila—S.A. Tecnico-Industriale	Trieste, Italy	Capacity Increase to	19,000 bbls.		Authorized				
*Badische Anilin & Soda Fabrik, A.G. & Deutsche Shell	Wesseling Area, W. Germany	Polyethylene & Ethylenzene pH			Projected	1955			
N. V. de Bataafsche Petroleum Maatschappij	Pernis, Holland	Luboil Ref. Exp. solvents Plt.	1,750 bbls. 16,000 tons/yr.		Under Constr. Completing	Early, 1955			
Benzene und Pet. Co. of Hamburg	Hamburg-Finkenwerder, Germany	Expansion	660,000 bbls.		Announced				
B. P. Benzin	Hamburg, Germ.	Distil. Unit	11,000 bbls.		Under Constr.	Sept., 1954			Staff
B. P. Benzin	Hamburg, Germ.	Platformer	5,000 bbls.		Under Constr.	Sept., 1954	U.O.P.		Procon
Condor, S.P.A. Per L'Industriale Pet. Chemica	Rho, Italy	Capacity Increase to	27,000 bbls.						
Egyptian Government	Cairo, Egypt	Refinery	20,000 bbls.		Planning			Lummus	Lummus
Egyptian Government	Suez, Egypt	Inc. Refn. Cap.	26,000 bbls.	$2,500,000	Planning				Lummus
Empresa Nacional "Calvo Sotelo"	Puertollano, Spain	Shale Oil Refg.	3,000 bbls.	$46,000,000	Under Constr.	1954	Basf, Lurgo	Basf, Lurgi	Basf, Lurgi
Esso Stand. Hatenaa.	Genoa, Italy	Cap. Increase Incl. Crker.							
Esso Standard, Societe Anonyme Francaise	Port Jerome, France	Double Stage Pipestill	25,000 bbls.	$3,715,000	Under Constr.	Mid 1954		Foster Wheeler	Foster Wheeler
Garrone	Genoa, Italy	Cap. Increase							
Greek Government	Greece	Refinery	25,000 bbls.	$20,000,000	Planned				
Imperial Chemical Industries	Wilton, England	Terylene Plt.	11 million lbs./yr.	$56,000,000	Under Constr.	Early 1955			
Industria Petrolifera e Chimica	Milan, Italy	Gasoline Fuel Oil Plt.	20,000 bbls.					Dr. Calogero Inglogio	
Industria Raffinazione Olii Minerali	Venice, Italy	Cat Cracker	10,000 bbls.		Planned				
Kali Chemie Co.	Nienberg, Germany	Bead Catalyst Plt.			Licensed		So-Vac.		
Mineralwel-und Asphaltwerke, A.G.	Ostermoor Germany	Reconstruction	1,196 bbls.						
Monsanto Chemical Company	Britain	Add Polystyrene			Under Constr.			Staff	Staff
A. P. Moeller	Copenhagen, Denmark	Thermal Cracking Plt.	2,000 bbls.	$3.5 million	Field Work				
National Oil Refineries, Ltd.	Llandarcy	Platformer	6,000 bbls.	$3 million	Engineering	End 1954	U.O.P.	Procon	E.B.Badger, Ltd.
A/S Norsk Amerikansk Mineralolkompagni	Vallo, near Tonberg, Norway	Lube Oil, Asphalt	1,000 bbls.						
Pechelbronn, S. A. E. M.	Merkwiller, France	Cap. Increase	1,850 bbls.		Authorized				
Permolio	Genoa, Italy	Cap. Increase							
Refineria de Petroleos de Escombreras S. A., (REPESA)	Escombreras Spain	Lube Oil Plt.	27,500 Metric Tons/Yr.		Under Constr.	1955		Foster Wheeler	Foster Wheeler
S.A. Cone. Ref. Pet. Portugal	Cabo Ruivo Plt., Portugal	Topping Unit	29,000 bbls.		Completing			Koch	Koch
S. A. Cone. Ref. Pet.	Cabo Ruivo Plt.	Cracking Unit	5,000 bbls.		Completing		So-Vac.	Hydro-Res.	Hydro-Res.
S. A. Cone. Ref. Pet.	Cabo Ruivo Plt.	Reformer	2,500 bbls.		Completing				
Shell Refining & Marketing Co.	Stanlow, U.K.	Hydro Desulfuration	4,800 bbls.		Under Constr.	Early 1955			
Sociedade Anonima Concessionaria da Refinacao de Petroleos em Portugal	Cabo Ruivo, Portugal	Kerosine Diesel & Lube Extrac.	6,600 bbls.		Engineering	1954	Edeleanu	Edeleanu	
Societa Per Azioni Raffineria Padana Olii Minerali (SARPOM)	San Martino di Trecate (Novara), Italy	Cat Cracker	2,880 bbls.		Planning	1955		U.O.P., E. B. Badger, Ltd.	S & W Badger Div.
	Trecate (Novara), Italy	Vacuum Unit	5,150 bbls.		Planning	1955		S & W Badger Div.	S & W Badger Div.
	Trecate (Novara), Italy	Poly Plant	315 bbls.		Planning	1955		Foster Wheeler	S & W Badger Div.
Societe Cherifienne des Petroles	Petitjean, Morocco	Feed Prep., T.C.C. Recov.	2,700 bbls.		Under Constr.	1954	So.-Vac.	Hydrocarbon	Hydrocarbon
Societe des Raffineries de Petrole de la Gironde	Ambes, France	Platformer	1,800 bbls.		Planning	1955	U.O.P.	U.O.P.	
Societe Generale Huile Petrolea	Lavera, France	Platformer	6,000 bbls.		Under Constr.	End, 1954	U.O.P.	Procon	E.B.Badger, Ltd.
Societe Industrielle Belge des Petroles	Antwerp, Belgium	Cat. Crker.	10,000 bbls.	$10,000,000	Under Constr.	1st Qtr., 1955	U.O.P.	Lummus	Lummus
S.I.B.P.	Antwerp, Belgium	Cat. Poly. Unit	3,000 bbls.		Under Constr.	1st Qtr., 1955	U.O.P.	Lummus	Lummus
Socony-Vacuum Italiana, S.P.A.	Naples, Italy	Cat. Poly.		$724,000	Design	2nd Qtr., 1955	Calif. Res.	Mediterranean Builders, Inc.	
Socony-Vacuum Italiana, S.P.A.	Naples, Italy	TCC			Design	2nd Qtr., 1955	Soc-Vac	Mediterranean Builders, Inc.	
South Africa Coal Oil & Gas	Coalbrook, Orange Free St	Plt. Ref. Expan.	3,500 bbls	$50.4 million	Under Constr.	1955		Kellogg	Kellogg
Standard-Vacuum Refining Company of South Africa	Durban, S. Africa	Asphalt Plt.	25,000 tons/yr.	$1,700,000	Completed				
*Standard-Vacuum Refining Company of South Africa	Durban, S. Africa	Poly. Plt.	1,225 bbls.	$1,000,000	Under Constr.	Jan., 1955			
Stanic Industria Petrolifera S.p.A.	Leghorn, Italy	Fluid Hydroformer	8,000 bbls.	$8,800,000	Process Design Stage	End 1955	S.O.D.	S.O.D., Compagnia Tecnia Industria Petroli, Staff	Compagnia Tecnia Industria Petroli
Trent Oil Prod. Development Co.	North Shields, England	Crude Plt.	11,500 bbls.	$4.8 million	Plans Approved				
*Turkish Government	Kutahya, Turkey	Nitrogen Plt.			Projected				

* Concluded on page 212

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Sheets, Plates, Bars, Wire, Pipe and Tubing now available through Chase warehouses and sales offices

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For more data on advertised products, use Readers' Service Cards, last page.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Turkish Institute of Minerals Prospecting	Batman, Turkey	Refinery	6,950 bbls.	$10,000,000	Under Constr.	End 1954	.....	Parsons	Parsons
Union Petrol Refinery Ltd.	Johannesburg, Union of South Africa	New Refinery	.....	$30 million	Projected	.....	.....	.....	.....
Universal-Matthey & Co.	England	Platform Cat.	.....	.....	Planned	Mid 1954	.....	.....	Procon
Near East									
Anglo-Iranian	Aden	New Refinery	100,000 bbls.	.....	Under Constr.	1954	.....	G. Wimpey (London) Middle East Bechtel	Middle East Bechtel Staff
*Arabian American Oil Company	Ras Tanura, Saudi Arabia	Fluid Cat. Hydroformer	12,500 bbls.	$9,825,000	Plans Approved	Jan., 1956	S.O.D.	Lummus, Arameo	Lummus
Bahrain Pet. Co.	Bahrain	Mod. of FCCU	36,000 bbls.	.....	Complete	.....	.....	Staff, U.O.P.	Staff
*Bahrain Petroleum Co.	Bahrain,	Vacuum Still	25,000 bbls.	.....	Planning	1955	.....	Lummus	.....
Fertilizers & Chemicals	Haifa, Israel	Hydrogen, Ammonia, Sulfuric Acid, Nitric acid, Ammonia Sulfur, Ammonia Nitrate	.....	$15,000,000	Under Constr.	Late 1954	.....	Chemico	Staff
Iraq Government	Baghdad Area	Refinery	24,000 bbls.	$25.2 million	Completing	.....	.....	Kellogg	Kellogg
*Jordanian Reconstruction Council	Mafrak, Jordan	Refinery	.....	$7,500,000	Planned	.....	.....	.....	.....
Kadimah Chemical Corp.	Haifa, Israel	Detergent Mfg.	10 tons	$500,000	Under Constr.	Late 1954	.....	.....	Staff
Mediterranean Refining Co.	Sidon, Lebanon	Refinery	6,250 bbls.	.....	Under Constr.	.....	U.O.P.	Bechtel Assoc. Procon	Bechtel Assoc.
*Saudi Arabian Government	Saudi Arabia	Ammonium Sulfate Plt.	400,000 Metric tons/yr. Plus 500 tons Dry Ice	.....	Proposed	.....	.....	.....	.....
Far East									
*Burma Oil Co.	Chauk, Burma	Distil. Unit	2,500 bbls.	.....	Under Constr.	.....	.....	.....	.....
Burmah Oil Co.	Pakutan	Refinery	.....	.....	Proposed	.....	.....	.....	.....
Burmah Shell	Bombay, India	Refinery	40,000 bbls.	$47 million	Projected	1955	.....	.....	.....
*Ceylon Government	Ceylon	Refinery	.....	.....	Negotiating	.....	.....	.....	.....
Daikyo Oil Co., Ltd.	Yokkaichi, Japan	Houdriflow & Cat. Poly.	3,800 bbls.	.....	Under Constr.	1954	Houdry & Calif. Res.	Houdry	.....
Koa Oil Co., Ltd.	Marifu, Japan	Platformer	1,200 bbls.	.....	Completed	.....	U.O.P.	U.O.P.	Local
Mitsubishi Oil Co. Ltd.	Tokyo, Japan	Vacuum Distillation Unit	2,000 bbls.	.....	.....	.....	.....	.....	.....
Mitsubishi Oil	Tokyo, Japan	Solvent Extraction & Dewaxing Processes	.....	.....	.....	.....	Texaco Dev.	.....	.....
Nippon Petroleum Refining Co., Ltd.	Yokohama, Japan	Modern. and Expansion	12,000 bbls.	.....	Under Constr.	1955	.....	McKee	McKee
Nippon Petroleum Refining Co., Ltd.	Kudamatsu, Japan	Platformer	1,200 bbls.	.....	Completed	.....	U.O.P.	U.O.P.	Local
Showa Oil Co., Ltd.	Tokyo, Japan	Platform. Unit	1,300 bbls.	$1,250,000	Completed	.....	U.O.P.	U.O.P.	Japan Gasoline Co.
*Showa Oil Company	Tokuyama, Japan	Refining Fac.	.....	.....	Planning	.....	.....	.....	.....
*Showa Oil Company	Tokuyama, Japan	Petrochemicals	.....	.....	Planning	.....	.....	.....	.....
*Showa Oil Company	Hiranawa, Japan	Alkyl Sulfonate	2 tons (Pilot Plt.)	.....	Testing	.....	.....	.....	.....
Standard-Vacuum Refin. Co. of India	Bombay, India	Refinery	25,000 bbls.	$35,000,000	Under Constr.	July, 1954	.....	S.O.D.	Lummus
*Standard-Vacuum Oil Co.	India	Refinery	10,000 bbls.	.....	Negotiating	.....	.....	.....	.....
Oceania									
A. I. O. C.	Kwinana, Australia	Refinery	60,000 bbls.	.....	Under Constr.	.....	.....	.....	Kellogg, Kellogg International, Costain-John Brown
Australian Oil Refining, Ltd.	Kurnell, Australia	Refinery	22,000 bbls.	.....	Under Constr.	1955	.....	S. & W. Badger Div. Ewbank & Partners, Christiani & Nielson, Foster Wheeler	S. & W. Badger Div.
Australian Shell Oil	Geelong	Crude Dist.	25,000 bbls.	$12 million	Under Constr.	Mid 1954	.....	.....	.....
*Australian Shell	Geelong, Australia	Cat. Cracking Unit	12,500 bbls.	.....	Projected	Mid 1955	.....	.....	.....
Caltex (Philippines, Inc.)	Batangas, P.I.	Refinery	13,000 bbls.	.....	Under Constr.	1954	.....	Foster Wheeler, McKee, Bechtel	Foster Wheeler
*Petroleum and Chemical Corp.	Silverwater, Australia	Petrochemical Plt.	.....	$7,000,000	Planned	.....	.....	.....	.....
Standard Vacuum Refining Co., Ltd	Altona, Aust.	Refinery	25,000 bbls.	$30 million	Under Constr.	End, 1954	.....	Braun, Soc-Vac.	Braun

*First appearance in tabulation. † Added capacity.

NOTE: Atlantic—Atlantic Ref. Co. Austin—Austin Co. Badger Mfg.—Badger Manufacturing Company E. B. Badger Ltd.—E. B. Badger & Sons Ltd. E. B. Badger Pty.—E. B. Badger & Sons Pty., Ltd. Barnes—W. M. Barnes Co. Bechtel—Bechtel Corp. Blaw-Knox—Blaw-Knox Construction Co. Braun—C. F. Braun Co. Brown & Root—Brown & Root Construction Co. Buckner—F. J. Buckner Corp. Calif. Res.—California Research Corp. Can. Kellogg—Canadian Kellogg Co. Cat. Constr.—Catalytic Construction Co. Chemico—Chemical Construction Co. Ch. Pro.—Chemical Process, Inc. C. B. & I.—Chicago Bridge & Iron Works Company Chiyoda—Chiyoda Chemical Engineering & Construction Co., Ltd. C. & I.—Chemical & Industrial Corp. Consd. Eng.—Consolidated Engineering Company Craig—A. F. Craig & Co. D & Z—Day & Zimmerman Delta—Delta Engineering Corp. Dresser—Dresser Engineering Corp. Ebasco—Ebasco Services, Inc. E&A—Ehrhart & Arthur, Inc. Edeleanu—Edeleanu Gesellschaft M. B. H. Etabadger, S.A.—Etablissement Badger, S.A. Fish—The Fish Engineering Corp. Ferguson—H. K. Ferguson Co. Fluor—Fluor Corp. Gas Plant Constr.—Gasoline Plant Construction Corporation Graff—Graff Engineering & Equipment Graver—Graver Construction Co. Grebe & Doremus—Grebe & Doremus Process Co. Gutte-Hutte—Gutte Hofnungs Hutte Hercules—Hercules Powder Co. Hudson—Hudson Engineering Corp. H.W.P.—Head Wrightson Process, Ltd. Hydrocarbon—Hydrocarbon Research, Inc. Hydro M—Hydrocarbon Mineraloel G.m.b.H Hydro E—Hydrocarbon Engineering S.A.R.L. Kaiser—Kaiser Engineers Kellogg—The M. W. Kellogg Co. Kellogg—P A—Kellogg Pan-American Koch—Koch Engineering Company Koppers—Koppers Co, Inc. Lummus—The Lummus Co. Macco—Macco Corp. McKee—Arthur G. McKee Co. M-C & S—Merritt-Chapman & Scott Corp. C. L. Olsen P. A. HydroRes—Pan-American Hydrocarbon Research Co. Parker—Parker, Steffens & Pearce Parsons—The Ralph M. Parsons Co. Petco—Petroleum Engineering Tool Co. Phillips—Phillips Petroleum Co. Pritchard—J. H. Pritchard Co. Procon—Procon, Inc. Quaker—Quaker Valley Constructors Ref. Eng.—Refinery Engineering Company Rust—Rust Engr. Co. S & B—Singmaster & Breyer Separator-Nobel Co. Soc. Vac.—Socony-Vacuum Oil Co. Southwestern—Southwestern Constr. Co. S. O. D.—Standard Oil Development Co. Sohio—Standard Oil Co. of Ohio Stearns-Roger—Stearns-Roger Manufacturing Co. Sunland—Sunland Refining Company S & W Badger Div.—Stone & Webster Engineering Corporation, Badger Process Division S & W Canada Ltd.—Stone & Webster Canada Ltd. Sweco—Southwestern Engineering Co. Tears—Tears Engineers Tellepsen—Tellepsen Construction Company Texaco Dev.—Texaco Development Corp. Texaco—The Texas Co. Texas Natural—Texas Natural Gasoline Corp. U.O.P.—Universal Oil Products Company J. G. White—J. G. White Eng. Corp.

300,000 PPH BOILER CLEANED CHEMICALLY IN ONE DAY!

Dowell engineers bring solvents to the job in truck-mounted tanks, along with all pumping and control equipment. They apply the chemicals as necessary—by filling, spraying, jetting, cascading or vaporizing.

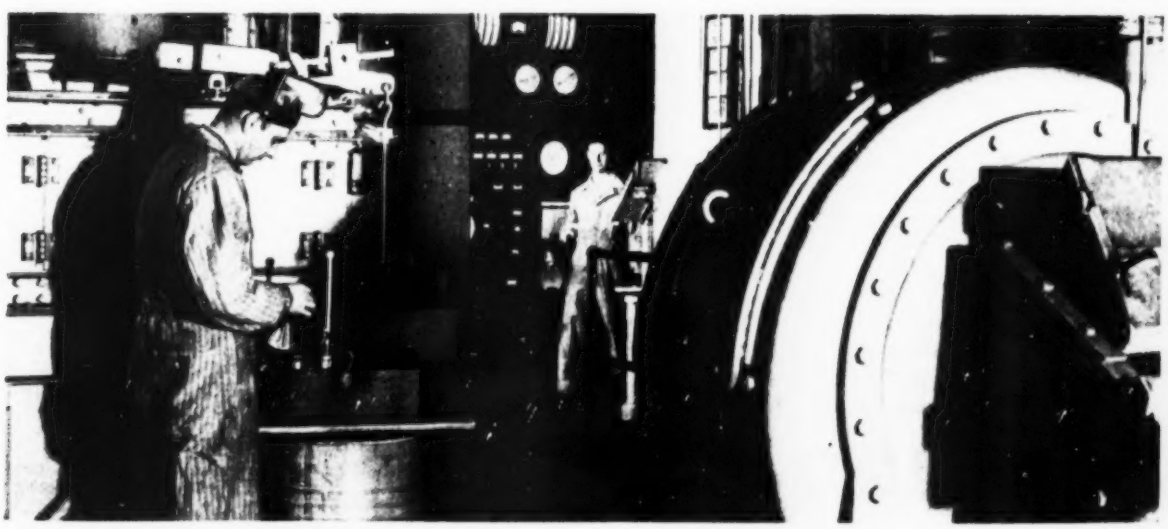
Comparative cases showed DOWELL cleaning took less time . . . removed more scale than mechanical methods

This is a case history on a 300,000 pound per hour boiler in a refinery. A routine inspection showed that iron oxide and silicate scale fouled the tubes. Dowell engineers cleaned the boiler with chemical solvents in less than 22 hours.

Dowell chemical cleaning is the standard method of removing deposits from boilers in this plant. Comparative tests showed that the chemical method was both faster and more thorough than the mechanical means previously used. The operator was surprised at the relatively large amounts of scale and sludge removed by chemical cleaning. Dowell has cleaned 25 of the 27 boilers in this plant. Several have been cleaned as many as three times on an annual basis.

Dowell liquid solvents go wherever steam and water flow, reaching surfaces inaccessible to other methods. No special scaffolding is required. *Dismantling and down-time are kept to a minimum.* Often, equipment may be cleaned while in operation.

Perhaps chemical cleaning could improve the efficiency of equipment in your plant—for example, heat exchangers, piping systems, tanks and process towers. For complete information and estimates, call the nearest of more than 130 Dowell offices, or write directly to Dept. D-31, DOWELL INCORPORATED, TULSA 1, OKLAHOMA.



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Laboratory demonstration shows foaming of highly alkaline solution in glass test cylinder.

Same solution after addition of 12 ppm of Bird-Archer Concentrol antifoam.

CONCENTROL

LOW COST CHEMICAL METHOD

FOR CONTROLLING FOAM

AND BOILER WATER CARRYOVER

LABORATORY PROOF

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A Bird-Archer 8 Point Service Engineer is as near as your phone. For friendly counsel call him or write directly to Bird-Archer outlining the details of your boiler operations.

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New Books . . .

Fluid Phenomena

Elementary Fluid Mechanics, Third Edition, John K. Vennard, John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. $5.50.

This third edition contains many important revisions of material found in its predecessors. The changes have increased its value to the beginner who has no experience in fluid phenomena.

While carefully reviewing and revising various pertinent points, the author has retained the pattern, level and general approach of his work. A new introductory chapter, for example, deals with generalizations on the subject of one dimensional fluid flow, while the addition of more problems raises their number to nearly 900.

Vennard has stated only general laws in many cases in order to convey basic ideas. As he says, "The beginner must follow theoretical developments, increase his imagination in visualizing physical phenomena, and be forced to think his way through problems of theory and application." To this end, the author has selected material which not only covers the fundamentals but has the maximum chance of practical use.

Catalysis Today

Catalysis, Volume I: Fundamental Principles, Part 1, Edited by Paul H. Emmett, Book Division, Reinhold Publishing Corporation, 330 West 42nd Street, New York 36.

This series of books provides research chemists with one of the best-integrated compilation of facts ever published on the physical chemistry of catalysis and catalytic processing. It presents comprehensive discussions not only of ideas and interpretations but also of the new concepts now associated with the field of catalysis.

The first two volumes of the series cover all the general approaches and tools used to obtain a basic understanding of both homogeneous and heterogeneous catalysis. Volume I covers physical adsorption, measurement of the surface area of solid catalysts, chemisorption, kinetic laws in surface catalysis, absolute rates of surface reactions, catalysts carriers, promoters, accelerators, poisons and inhibitors, catalyst preparation, and magnetism and catalysis. Volume II concludes the discussion of fundamental theory and classifies catalysts according to the current ideas of solid state physics.

This series will prove of great value to every physical chemist whose work involves catalytic reactions. It's a "must" for the reference shelves of technical libraries.

Lubricants and Grease

Petrole Proprieties et Utilisations, Tome III. Les Lubrifiants et la Technique du Graissage, Joseph Prevost, Presses Documentaires 28, Rue Saint-Dominique, Paris-7e, France. Frs. 1950 (about $5).

This work is a compilation of professional courses which the author has presented to students at the Centre Technique d'Enseignement Ouvrier, Course Professionnels des Industries de la

New Books . . .

Chemie. Written in French it is particularly recommended to engineers, manufacturers and others in the field of lubricants and grease. Its style is clear and easy to understand. Filled with much late information, it will make an excellent reference book for those who have a knowledge of the French language.

Marketing of Chemicals

Marketing Research in the Chemical Industry, R. S. Aries & Associates, Chemonomics, Inc., 270 Park Avenue, New York 17. $1.

The primary purpose of this 56-page book is to assemble the literature on the marketing of chemical products so that readers can put it to work in a practical way. It does not pretend to meet the needs of a broad treatment of the entire subject, but rather collates and evaluates what is known about it and presents a guide on how chemical marketing and market research are conducted. Many voids in the literature were encountered in compiling the work; these were filled from the experience of the authors.

Divided into seven chapters, the book covers the history, and basic characteristics of the chemical industry, and growth of marketing research in the chemical industry.

Acid Corrosion

Condensate Well Corrosion, Condensate Well Corrosion Committee of the Natural Gasoline Association, 422 Kennedy Building, Tulsa 3, Okla. Single copies, $6; in lots of ten or more, $5.50 each.

This book presents the current knowledge of the mechanism of anaerobic acid corrosion as well as the behavior of steel and steel alloys in such systems. It represents a summary of ten years of cooperative research and field studies by a committee composed of metallurgists, chemists and engineers of 31 oil companies. It contains fundamental data useful in the study of corrosion in all petroleum production systems. It will be highly valuable where corrosion due to carbon dioxide, dilute organic acids or other weak acids is encountered.

API Publishes List of Oil Industry Displays

To help oil men and others responsible for the preparation of oil industry displays, the American Petroleum Institute has compiled a list of exhibits which are known to be available on loan in various sections of the country.

The list has just been published in the form of a catalog containing illustrations, details of the exhibits, and the identity of the individuals or companies to contact. The 20-page catalog is called "Exhibits About Oil."

The exhibits are suitable for both industry and general audiences. They cover petroleum exploration, production, refining, transportation, and general subjects.

Single copies of the new catalog may be obtained gratis through any district office of the Oil Industry Information Committee.

"that new snap-on pipe insulation"...

¢heaper in the long (or short) run!

Whether you have a pipe insulation job involving 20 or 20,000 feet, it will pay you to use G-B ULTRAFINE PIPE INSULATION — the new one-piece pipe insulation molded of fine glass fibers that comes in 6′ sections. This revolutionary time-saver costs no more than other insulations — and offers application cost savings up to 50%!

Any man can readily handle 6′ sections that only weigh several pounds. To apply, simply spread the single seam, slip it over the pipe, let it snap perfectly in place. You can hold the seams together with staples — no wiring or banding necessary. Then finish as desired — even painting the insulation if you wish. If it rains before the job is finished, there is no harm done. Ultrafine does not absorb moisture, has stood up under 10" of rainfall, followed by hot days and high humidity without damage of any kind.

G-B ULTRAFINE PIPE INSULATION has many other unusual properties that save time and money. It's flexible, resilient . . . won't break or crumble . . . outstanding in thermal efficiency . . . dustfree . . . easy to cut with a knife. Try some right away, and you'll never insulate hot or cold lines any other way!

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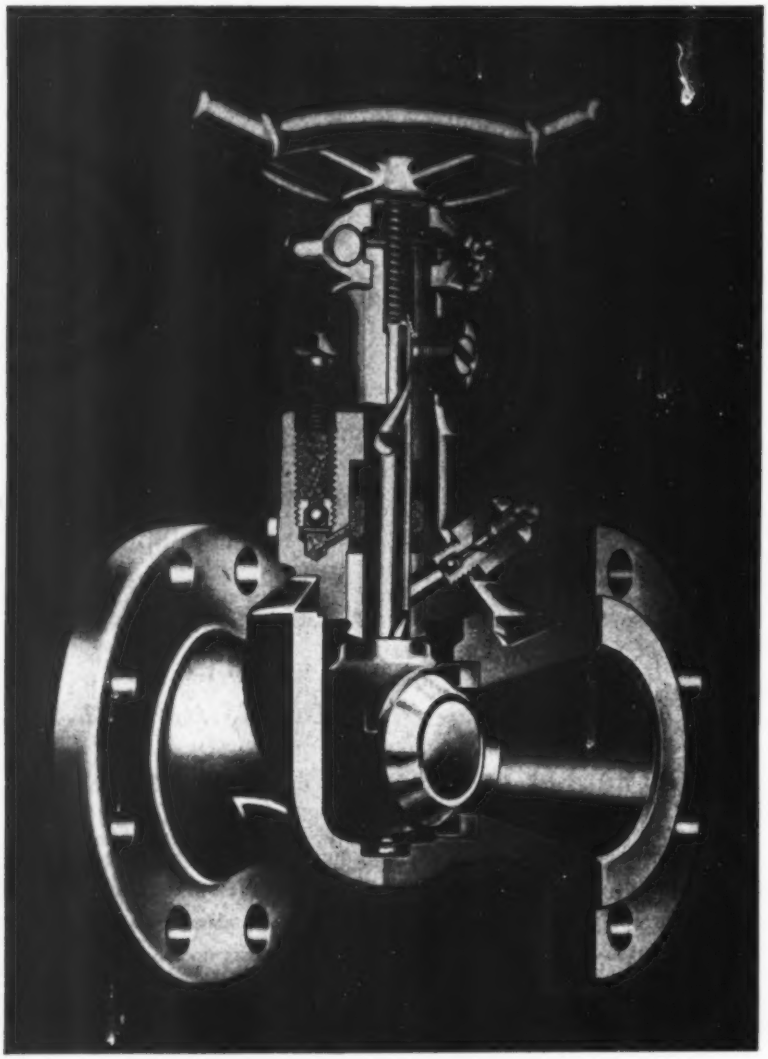

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A.S.A. CLASS	VALVE SIZES	MIN. DIA. OF OPENING THRU VALVE	A.S.A. CLASS	VALVE SIZES	MIN. DIA. OF OPENING THRU VALVE
150 lb.	2″	1½″	600 lb.	6″	4″
	2½″	2″	1500 lb.	1½″	1″
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	4″	3″	2500 lb.	1½″	1″
300 lb.	6″	4″		2″	1″

The ORBIT FORGED STEEL LP-GAS VALVE has a wide reputation through its ability to hold light vapors at low cost maintenance. This line of Valves features Friction Free Seating with no Lubricant needed to effect a positive shut-off.

Recommended and widely used in the manufacturing, storage and handling of Petroleum Hydrocarbons, Anhydrous Ammonia and many chemicals where Carbon or Stainless Trim Valves are required.

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Who's Meeting . . .

AIChE at Washington . . .

. . . **No** wonder ammonia is growing so fast as a petrochemical. Fertilizer use has more than doubled in the past 12 years and present consumption is still far below the level of use suggested by state agricultural colleges for maximum crop yield and farmer profit (E. C. Kapusta, National Fertilizer Association).

. . . **New** processes in fertilizer production include ammonium nitrate manufacture where a reaction between preheated ammonia and nitric acid yields a molten ammonium nitrate of the desired moisture level (J. J. Dorsey, Commercial Solvents Corporation).

. . . **Urea** is growing in popularity too. Claims for Chemico process include high efficiency of raw material conversion and simple recovery of excess raw materials (L. E. Cook, Chemical Construction Company).

. . . **Even** small plants can justify fertilizer manufacture. With new processes, small plants of 50,000 tons annual output can run as economic units (F. A. Retzke, G. F. Sachsel and R. B. Filbert, Batelle Memorial Institute).

. . . **Potentialities** for electronic computers are still being discovered. Time spent in scale model testing may be saved by feeding into the machines data based on laboratory experiment and telling from the results how the process might be worked out on a large scale.

NGAA at Odessa . . .

. . . **Many** plants aren't getting accurate gas measurement because standards haven't been followed. Most important is the orifice plate. Items to watch out for around the orifice itself: rounded upstream edge, dirt accumulation and protruding fins (H. B. Beck, American Meter Company).

. . . **Gasoline** plant operators needn't take for granted periodic replacement of equipment, e.g., exchanger tubes. Recent studies by NGAA show that the culprit is corrosion from sour gas which can be measured and perhaps brought under control. Cooperative, industry-wide study is believed to be a much better approach to the corrosion problem, rather than an approach by each individual plant (E. W. Wallace, Shell Oil Company).

. . . **Unbalanced** explosion pressures in two-cycle engine power cylinders can be very detrimental. Besides breaking down lubrication and increasing cylinder and piston wear, bearing life decreases. To insure equal loading to each power cylinder, check exhaust temperatures and cylinder pressures. If not in balance, start with adjustment of air intake valves and then work on the fuel injection valves (Vern Ford, Clark Brothers Company).

. . . **Don't** change valve lifts on compressor valves without consulting the compressor manufacturer. Through research, valve lifts have been critically designed to give maximum efficiency and durability. Any change from the design valve would likely be disadvantageous (A. R. Worster, Ingersoll-Rand Company).

. . . **There** seems to be no ready answer to the question of when should piston rings be changed on compressor cylinders. Some operators use lubricant consumption as the guide, but fuel economy is probably more important. Blow back from piston wear can really play havoc with fuel economy (C. J. Kremer, Lee Cook Manufacturing Company).

. . . **Don't** look for much more petrochemical expansion in West Texas beyond what is indicated by the present carbon black and sulfur picture. Reason: lack of non-hydrocarbon materials, water, and transportation advantage (H. A. Legatski, Phillips Petroleum Company).

. . . **But** don't discount the growth of West Texas as an oil and gas center. Gasoline plants in the Permian Basin now number 62. Two sulfur extraction plants are to be added to the existing eight and another one has been proposed. Biggest boom in the area: underground storage (V. E. Cottingham, North Basin Engineering Committee).

. . . **Pipe** line companies are worried about how long they can continue to buy residue gas from gasoline plants. Reason: if pipe line companies aren't allowed a more reasonable return on exploration for formation gas, the consumer won't get enough gas and the industry will topple. Residue gas is presently a problem child for the gas industry since its production is determined by the demand for oil and not by the demand for gas (Paul Kayser, El Paso Natural Gas Company).

API at Detroit . . .

. . . **The automotive** industry regards the future of the new gas turbine for automobiles with a degree of optimism. But extensive development work on the turbine will be needed to enable it to compete favorably with the automotive piston engine. Reason: high fuel consumption at idle and light loads. Best bet is that the first commercial service will be in the bus and truck field (Max M. Roensch, General Motors Corporation).

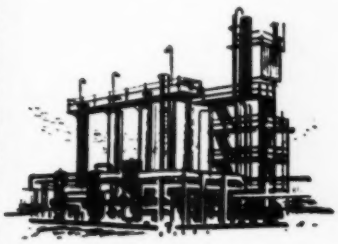
. . . **The battle** still rages over what to do about combustion engine deposits. All agree, however, that pre-ignition is a little understood phenomena which threatens to limit further improvement in fuel efficiency. Pre-ignition and knock are distinct phenomena but one can lead to the other (W. E. Betonney, E. I. du Pont de Nemours & Company, Inc.).

WPRA at San Antonio

. . . **As much** as $100,000,000 was lost in diverting butane from motor fuel to other petroleum blends during 1953. Blamed for the loss: failure to rigorously exploit existing knowledge of the simple interrelationships of ASTM Reid vapor pressure, ASTM distillation character-

problem

To meet ethylene consumer demand for a product that is essentially free of acetylene.



solution

GIRDLER developed catalysts to selectively hydrogenate the acetylene in the presence of the ethylene. Acetylene content was cut more than 99% giving consumers what they wanted:

Ethylene with less than 50ppm of Acetylene

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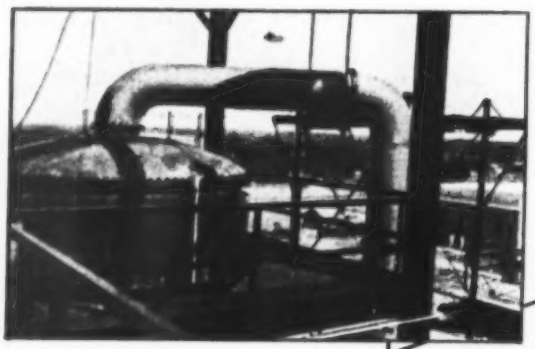
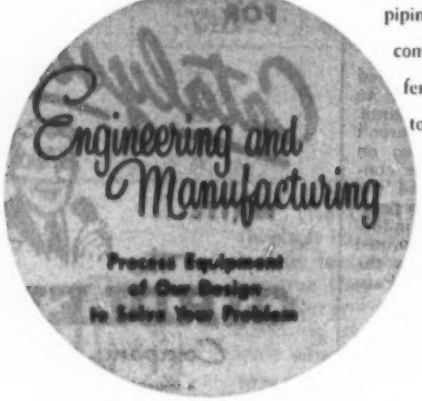
Process Piping



...produced with a combination of engineering guidance and manufacturing skill.

The engineering guidance manifests itself chiefly in two ways: (1) in designing the layout and in selecting materials and sizes to fit the processing problem when such cooperative help is desired by the purchaser; or (2) in double-checking specifications. Both of these engineering services are backed by broad knowledge of processing and an appreciation of how process piping is suppose to function and what is needed to resist corrosion, pressure and temperature; also how to handle best the inevitable expansion when a cold-hot cycle is in the operation.

The manufacturing skill comes from highly experienced craftsmen who have spent many years in fabricating process piping, utilizing over the years *all* the commercially used stainless and non-ferrous materials and knowing how to work with them.



We'll **be glad to help design your process piping layout or quote on your own design and specifications.**

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Who's Meeting . . .

istics, and permissible butane content (T. W. Legatski and H. J. Elder, Phillips Petroleum Company).

. . . **Catalytic** cracking has taken a big bite into the straight-run middle distillates so that refiners are having to blend more and more cracked distillates to meet diesel demand. Cracked distillates, though, have lower cetane numbers so efforts are being made to come up with a good improver. After extensive tests, amyl nitrate looks like one of the best bets. Advantages: cost, safety, and maintenance (G. C. Wilson and F. A. Desmond, Ethyl Corporation).

. . . **Latest data** on Fluid Coking indicates that the yield of gas oil for catalytic cracking approaches twice that from delayed coking. Both coke and gas yields are lower with Fluid Coking and naphtha yield drops as much as 10 percent. Naphtha octane number is some 10 points higher with fluid versus delayed coking (H. Z. Martin, F. T. Barr, R. W. Krebs, Standard Oil Development.

. . . **Indiana Standard's** new catalytic reforming process (ultraforming) turns out to be a low pressure operating scheme. The platinum-on-alumina catalyst is maintained at high activity by a novel regeneration technique that goes beyond mere carbon removal. The process favors conversion of paraffins to aromatics, giving good results even with charge stocks low in naphthenes (see page 153 of this issue for details).

. . . **Operating data** are now available on Unifining, a catalytic hydrogenation process that cleans up a variety of refinery stocks by nearly complete removal of sulfur, nitrogen and metals. (Details on page 165.)

. . . **Details** on the Phillip's pebble heater process show promises of higher ethylene and acetylene yields from cracking light hydrocarbons. New features are higher temperatures, shorter contact times and lower pressure (see page 171 of this issue for more details).

. . . **A new kink** in an old process makes 100 percent mercaptan removal possible from gasolines. The new process is termed Dualayer. (See page 150.)

. . . **Roland V. Rodman** was re-elected president of WPRA. Also reelected: vice presidents Reid Brazell, H. J. Kennedy, F. L. Martin and J. W. Vaiden. New directors include W. J. Carthous, W. H. Garbade, L. L. Leabo, E. B. McConnell, J. B. Smith, and C. C. Tate.

In the Future . . .

. . . **New Jersey** Section of AIChE will discuss "New Techniques in Chemical Engineering" (Newark, May 11).

. . . **Short** Course in Gas Technology will include two papers on low temperature recovery and stabilization (Kingsville, Texas, June 2-4).

. . . **ASTM** E-14 Committee expects the largest meeting ever on mass spectrometry (New Orleans, May 24).

. . . **Program** for the Southwestern Gas Measurement Short Course will be devoted for the most part to classroom sessions (Norman, Okla., April 13-15).

. . . **Cornell** University plans its annual summer laboratory course in electron microscope techniques with guest lec-

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In Europe, South America and throughout North America . . . wherever refiners require unqualified results in the treatment of petroleum emulsions . . . Howe-Baker custom built installations will be found meeting the most exacting demands. Because of this consistent performance Howe-Baker customers become our best salesmen. Refer your desalting problems to us.

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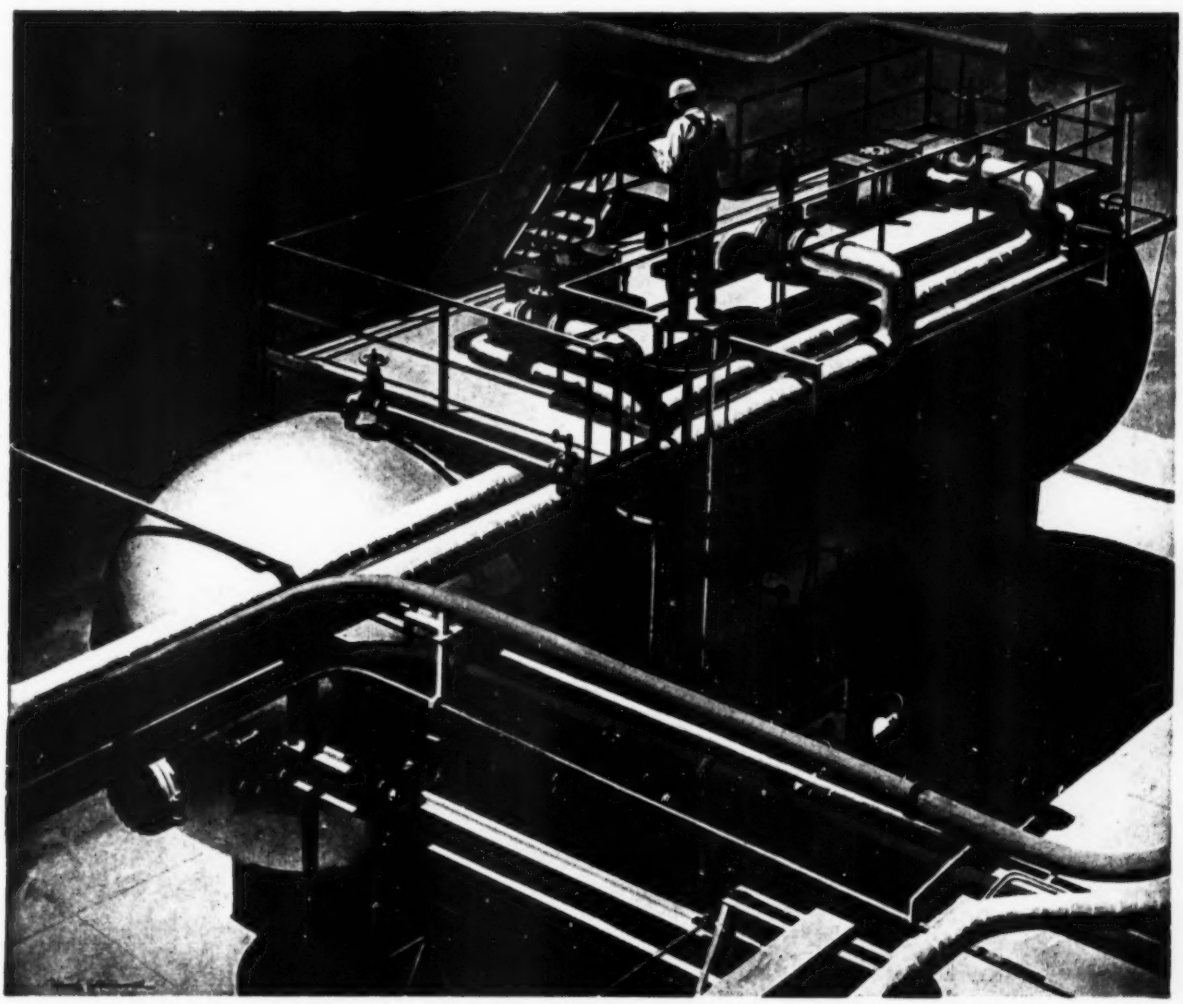

"Featherweight"®

85% MAGNESIA INSULATION

Desalters and piping in West Texas Refinery, insulated with "Featherweight" 85% Magnesia and covered with weatherproofing materials. Insulation contractor: Willard A. Selle Co., Inc., El Paso, Tex.

helps refinery conserve dollars

"Save heat—save money" is an operating rule that holds true for almost every industry. In the refinery illustrated here, heat is effectively conserved by the use of "Featherweight" 85% Magnesia, used to insulate various pieces of hot piping and equipment.

For any industrial insulation use, "Featherweight" proves to be a thrifty choice. By itself this material (85% basic carbonate of magnesia and asbestos fiber) has an effective insulating range up to 600°F. Used with K&M Hy-Temp Insulation, its range is extended to 1900°F.

Hy-Temp is applied directly to the hot surface, and "Featherweight" is used as the second layer. The two materials, when applied with staggered vertical and horizontal joints, eliminate heat loss which occurs on single layer installations when the expansion of hot piping and equipment causes joints to open.

These K&M insulations will last the life of the equipment they serve, will withstand moisture, vibration, and frequent temperature change. With a waterproof jacket, they serve equally well outdoors. Both materials are supplied in various sizes and thicknesses.

Your K&M distributor is an experienced applicator who will gladly give you more information about these heat-saving, money-saving K&M insulations. Or write directly to us.

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Who's Meeting . . .

turers, Dr. James Hillier and Dr. C. E. Hall (Ithaca, New York, June 14-26).

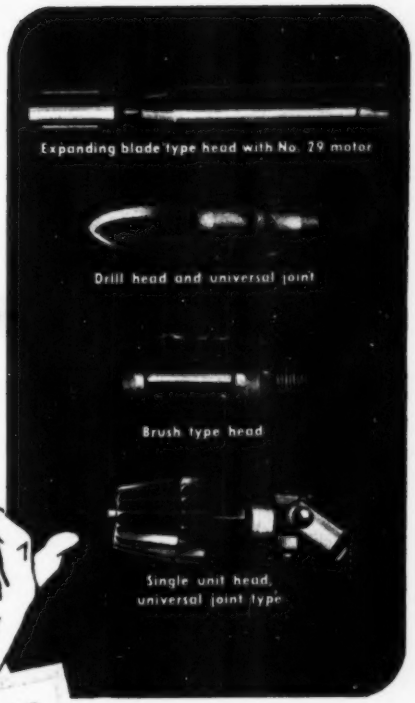
. . . **NPA** will feature a symposium on the controversial question of gasoline additives (Cleveland, April 14-16).

. . . **AGA** Corrosion Conference will include a panel discussion on pipe coatings (Quebec, Canada, April 20-23).

IN THE FUTURE

APRIL	
12-15	Society of Automotive Engineers (National Aeronautic Meeting), Statler Hotel, New York.
14-16	National Petroleum Association (51st Semi-Annual Meeting), Cleveland Hotel, Cleveland.
21-23	Natural Gasoline Association of America (33rd Annual Convention), Baker Hotel, Dallas.
MAY	
3- 5	American Petroleum Institute (Lubrication Committee), Skytop Lodge, Skytop, Pa.
3- 5	Air Pollution Control Association (Annual Meeting), Patten Hotel, Chattanooga, Tenn.
3- 7	American Petroleum Institute (Safety & Fire Protection Committees, Midyear Meeting), Chase-Park Plaza, St. Louis.
9-12	Liquefied Petroleum Gas Association (Annual Convention), Conrad Hilton Hotel, Chicago.
10-13	American Petroleum Institute (Division of Refining, Midyear Meeting), Rice Hotel, Houston.
16-19	American Institute of Chemical Engineers, Springfield, Mass.
17-21	National Fire Protection Association, (58th Annual Meeting), Statler Hotel, Washington, D.C.
20-21	National Industrial Conference Board (38th Annual Meeting), Waldorf-Astoria, New York.
27-28	Western Petroleum Refiners Association (Regional Meeting), Broadview Hotel, Wichita, Kan.
JUNE	
6-11	Society of Automotive Engineers (Summer Meeting), Ambassador and Ritz-Carlton Hotels, Atlantic City, N.J.
9-11	Oil Industry Information Committee, Edgewater Beach Hotel, Chicago.
13-18	American Society for Testing Materials (Annual Meeting and Exhibits), Sherman Hotel, Chicago.
21-25 (tentative)	American Institute of Electrical Engineers (Combined Summer and Pacific Meeting), San Francisco.
24-25	Western Petroleum Refiners Association (Regional Meeting), Leonard Refineries, Inc., Auditorium, Alma, Michigan.
27 to July 1	Petroleum Equipment Suppliers Association, Manoir Richelieu, Murray Bay, Quebec, Canada.
SEPT.	
8-10	Oil Industry Information Committee, Conrad Hilton Hotel, Chicago.
12-16	American Institute of Chemical Engineers, Hotel Colorado, Glenwood Springs, Colo.
12-17	American Chemical Society, New York.
15-17	National Petroleum Association (52nd Annual Meeting), Traymore Hotel, Atlantic City, N.J.
23-24	Western Petroleum Refiners Association (Regional Meeting), Henning Hotel, Casper, Wyo.
27-29	American Institute of Electrical Engineers (Joint Meeting with Tulsa Engineers Club), Mayo Hotel, Tulsa.
OCT.	
7-8	California Natural Gasoline Association (29th Annual Fall Meeting), Ambassador Hotel, Los Angeles.
21-22	Western Petroleum Refiners Association (Regional Meeting), Garrett Hotel, El Dorado, Ark.

"SMALL SIZE... BIG RESULTS!"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Airetool small tube cleaners are designed to make it easier to thoroughly remove hard or soft foreign deposits of any type from condensers, heat exchangers, or other small diameter tubular equipment; quickly and with maximum safety to inside tube surfaces.

Used with either flexible drive or a universal joint, and powered by husky air-driven Airetool motors, these small cleaner heads quickly remove foreign deposits from straight or bent tubes of ⅝" to 2" I.D.

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Every type of heat exchanger and condenser tube, even those completely plugged, can be quickly cleaned by powerful Airetool outside mounted air-driven cleaners. Geared or direct-drive — positive handle control valve; drill is cooled by positive flushing system . . . sound deadening muffler.

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What's Happening in the Industry . . .

85 Labs Taking Part in NGAA Analysis Project

Seventy-six plant and research laboratories of 48 oil companies and 9 commercial laboratories are participating in a hydrocarbon analysis project sponsored by the Natural Gasoline Association of America. The laboratories are analyzing a synthetic liquid sample, a de-ethanized natural gasoline, blended for the purpose by the Special Products department of Phillips Petroleum Company. Exact composition of the sample is known to only the blender.

While most of the analyses will be made by low temperature distillation, 14 will be by mass spectrometry, 15 by infrared, 1 by the Fracton method and 1 by absorption index. A. J. Miller, of Phillips Petroleum and chairman of the NGAA Fractional Analysis Committee, is in charge of the project.

A second phase of the same project will be the analysis of a natural gas sample by the same group.

New CNGA Chapter Slated For San Francisco Area

The Executive Committee of the California Natural Gasoline Association has authorized the chartering of a chapter in the San Francisco Bay area, bringing to four the number of such chapters in California. Others are at Ventura, Taft and Los Angeles Basin. CNGA President Fred L. Hartley said the new chapter will have its initial meeting some time this month. Warren H. Kraft, Honolulu Oil Corporation and past CNGA president, is acting as chairman pro tem during the organizational procedure.

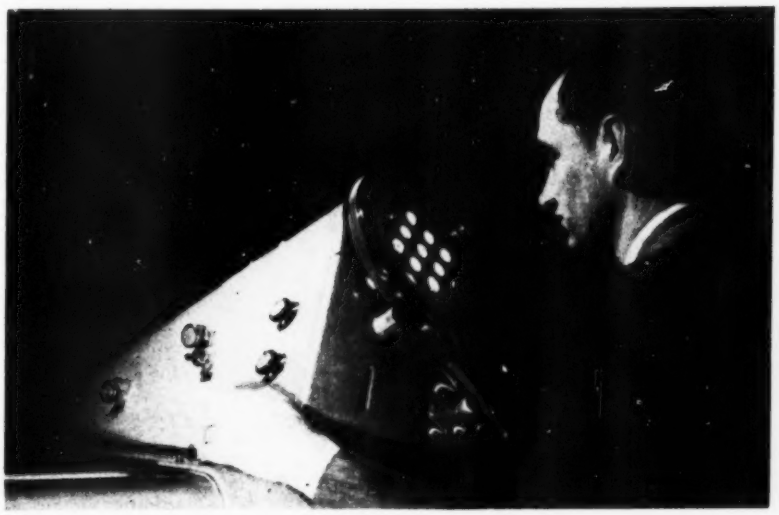
Texaco Elevates Gee to Top Petrochemical Post

William P. Gee, assistant to the president of The Texas Company, has been placed in charge of all petrochemical activities for Texaco. At the same time, A. W. Baucum, assistant to the vice president in charge of the Producing department since 1950, was appointed assistant to the president to succeed Gee.

Gee

Gee, who represents The Texas Company as a director and member of the executive committee of Jefferson Chemical Company, in which Texaco has a 50 percent interest, will also be responsible for the company's activities in the field of synthetic rubber. He had been assistant to the president since 1951.

Baucum is also a vice president and director of Texaco Exploration Company, a wholly owned producing subsidiary operating in Western Canada.



SOD Uses Big Picture in Research—

Using this electron microscope—only one of its kind in the U. S. oil industry—research scientist Paul Skiba of Standard Oil Development Company looks at objects 10,000 times smaller than a single human hair. SOD employs this powerful electronic device to study structure of greases, carbon blacks, petroleum chemicals, synthetic rubber and other products. The microscope can directly magnify items on its TV-like screen 60,000 times. Magnification can be boosted to 150,000 times by photographic enlargement with the use of a 35 mm. camera behind the screen.

Bureau of Mines Reports January Oil Demand Up

Compared with January, 1953, the total demand for all oils last January was up 4 percent, according to the Bureau of Mines' monthly petroleum statement. January, 1954, demand: 8,990,000 barrels a day, including exports of 328,000 barrels a day, and domestic demand of 8,662,000 barrels a day. Compared with the same month last year, the January exports were down 15.1 percent, and the domestic demand was up 4.9 percent.

Indiana Standard Names Friden Personnel Aid

James E. Friden has been appointed assistant personnel supervisor in the Whiting, Ind., research laboratories of Standard Oil Company (Indiana). Friden joined the research department in 1948 as a chemical engineer at Whiting.

New Seminar Date

To avoid conflict with the Easter season the date of John Zink Company's fourth annual process heating seminar has been changed to April 24, Robert Reed, chief engineer, has announced.

The seminar is scheduled at the company's plant in Tulsa. Four papers will be presented.

Stanolind Decides to Buy Carthage Hydrocol

Stanolind Oil & Gas Company has decided to exercise its option to acquire the stock of Carthage Hydrocol, Inc. The deal whereby the company will take over Carthage Hydrocol's gas synthesis plant at Brownsville, Texas, will probably be concluded this month.

Stanolind's decision to buy the stock ended almost four months of study of the situation by the company with the assistance of engineering firms contracted for the purpose.

Carthage Hydrocol's 6000-barrel-a-day plant at Brownsville had been plagued by mechanical and process problems throughout its operation. It has been closed down since June, 1953. The company was organized and financed originally by eight oil, gas and engineering firms from whom Stanolind will acquire the stock. In taking over Carthage Hydrocol, Stanolind will guarantee payment of the Reconstruction Finance Corporation loan to Carthage of over $17.5 million, thus assuring payment of one of the agency's largest outstanding loans.

E. F. Bullard, Stanolind president, said that it will be many months before the synthesis plant will be in condition to start operations but "we are confident that this plant can and will ultimately be made to operate."

Egloff to Add to Honors

The 1954 Carl-Engler-Medaille, Germany's highest award in the field of mineral oil science, will be awarded to

added reason to—

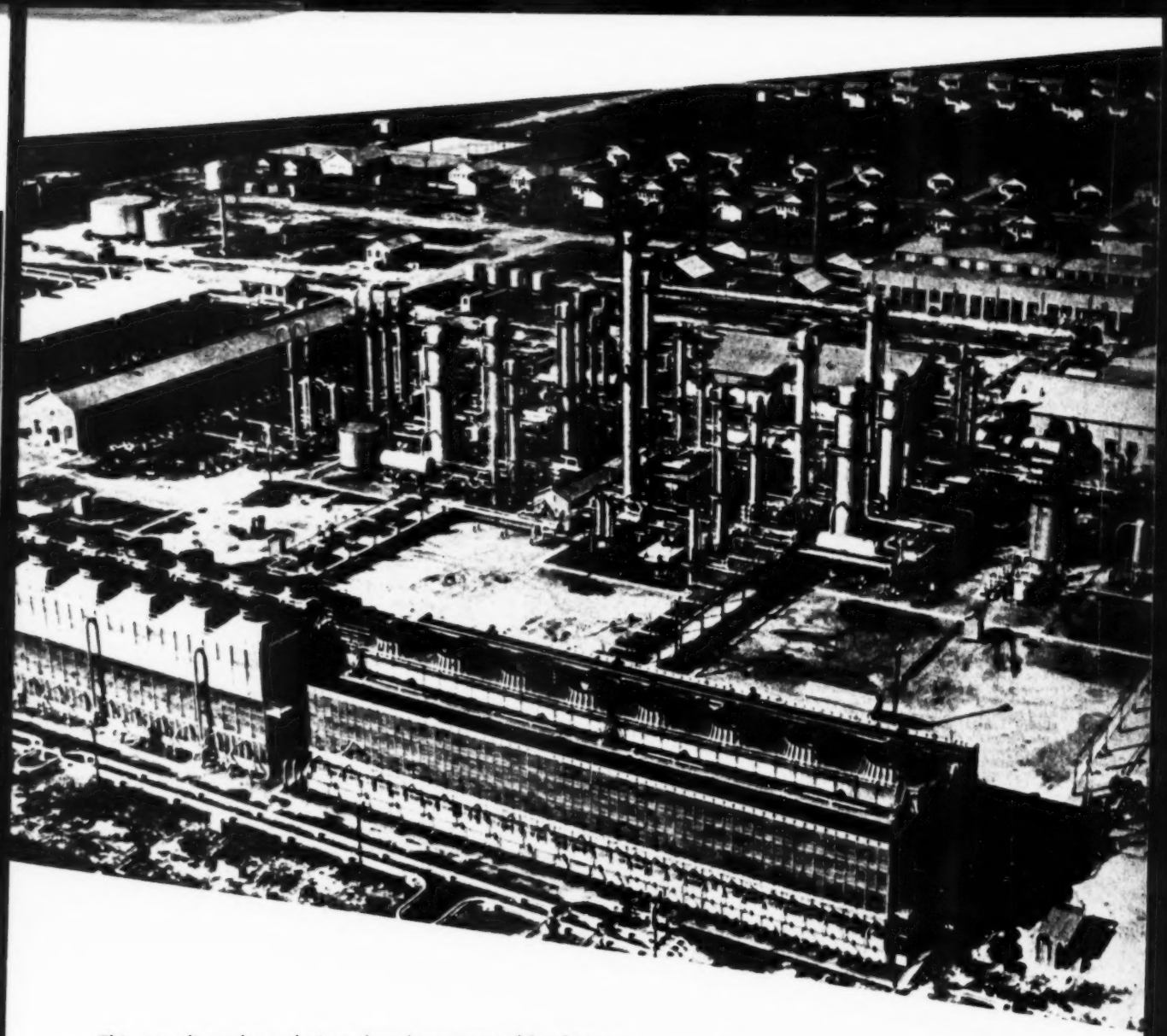
Take it up with Stearns-Roger

Moving into its new Home Office building, designed and constructed by Stearns-Roger to its own requirements, this Company improves substantially its ability to serve a fast-developing America.

In this one L-shaped building (with 90,000 square feet of floor space and capable of future expansion) every modern facility is provided for more than 500 executives, engineers, draftsmen, and office personnel.

Stearns-Roger construction crews are continuously at work on a long list of projects located in many states, the value of which totals many millions of dollars. From its Denver shops, special equipment totalling many trainloads rolls out annually to virtually every state in the Union and to many foreign countries.

For nearly three quarters of a century . . . the power, mining, metallurgical, chemical, sugar, and gas & oil industries have learned that it pays to "TAKE IT UP WITH STEARNS-ROGER" . . . whether the requirement is a complete new plant, or enlargement or modernization of existing plants.



This recycling plant, designed and constructed by Stearns-Roger, is the largest gas processing plant in the industry and is owned by 33 separate interests, including 13 major companies.

It processes well over 500 million cu. ft. of gas per day. Absorbers operate at 1800 p.s.i. and treated gas is re-compressed to 3500 p.s.i. for return to producing formations. Much of the equipment, manufactured in our Denver shops, was limited in size only by railroad weight and clearance limits to the plant site.

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DENVER • HOUSTON

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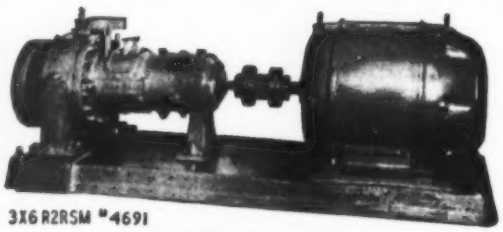
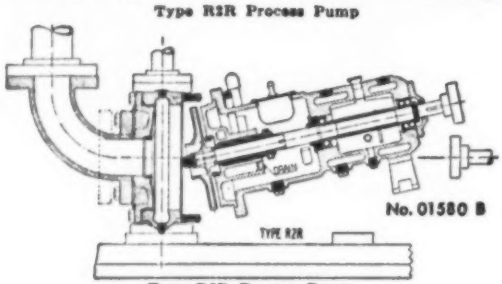
DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

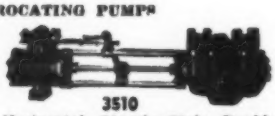
DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R. Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
Capacities: 50 to 2000 Gallons per minute.
Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

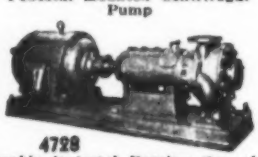
4040H
Close Coupled Centrifugal Pump



3510
Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids

4043 AA
Pedestal Mounted Centrifugal Pump

3833
Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



4728
Double Pedestal Bearing Centrifugal Pump

3556
Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

What's Happening. . .

Dr. Gustav Egloff, director of research for Universal Oil Products Company. Announcement of his selection was made by Prof. G. Schlicht, president of the German Institute of Petroleum and Coal.

Egloff will receive the medal in October during the institute's annual congress, to be held in Essen, West Germany.

Phillips Develops Polyethylene Plastic

An entirely new type polyethylene plastic has been developed by Phillips Petroleum Company. According to the company announcement, the new plastic can be produced by a unique process requiring a substantially lower investment than existing processes.

A semi-commercial plant to make the plastic will be built at Adams Terminal on the Houston Ship Channel where the company is already expanding its large petrochemical manufacturing facilities. The company anticipates building a large plant after a sampling of the plastic goods manufacturers using production from the new unit.

The announcement said the new plastic greatly improves such products as film-type wrapping for vegetables and fruits, plastic tubing and coated paper.

Humble Promotes Four At Baytown Refinery

Promotions of four members of the Engineering division at its Baytown, Texas, refinery have been announced by Humble Oil & Refining Company. O. L. Clevenger, N. O. Felps and N. D. Jones, Jr., have each been designated senior mechanical engineer (supervisory), and T. S. Fennema, engineering specialist.

Clevenger will be in charge of the mechanical engineering group in the Design department; Felps will be in charge of the lube extraction and treating group in the Maintenance department; Jones will be in charge of the civil engineering group in the Design department, and Fennema will work on problems which cannot be effectively handled by the regular engineering groups.

World Petroleum Congress Set for Rome Next Year

The Fourth World Petroleum Congress will be held June 6-15, 1955, in Rome, Italy. At the forthcoming Congress, over 200 papers on petroleum topics of international significance will be presented by leading university and industrial scientists from all over the world. About 4000 representatives are expected to attend the meeting.

Disaster Plan Outlined For Chemical Concerns

The Commerce Department has published a booklet outlining a plan for chemical and allied industries in case of disaster. The 50-page publication covers plant organization for emergency conditions, such as enemy attack. It may be

For more data on advertised products, use Readers' Service Cards, last page.

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

To Answer Your "Double" Corrosion Problems

Many heat transfer installations must stand up under corrosive attack from two different media at the same time . . . one inside and one outside the tubes. In many applications, tubing of a single metal cannot withstand this double onslaught for very long. The answer is found by combining two metals, each highly resistant to one of these corrosive conditions, into a Duplex tube.

The story of Bridgeport Duplex Tubing, drawn from 15 years of successful service, is now graphically told in Bridgeport's newly published *Duplex Tubes Technical Bulletin No. 1954*. In concise, quick-reading language, supported by ample illustrations and comprehensive charts and tables, this Bulletin describes the most important features of construction, application, selection and installation of Duplex Tubing to profitably solve many double corrosion problems.

Variety of Metal Combinations

Bridgeport Duplex Tubes are supplied in many combinations of ferrous and nonferrous metals, each chosen to resist the particular combination of corrosive media involved.

For chemical plants producing colorless formaldehyde, Duplex Tubing with Admiralty Brass outside for brackish water, and aluminum inside for formaldehyde has made an excellent record. Equal results have accrued in oil refining and natural gas processing with stainless steel outside to resist various corrosive petroleum vapors, and copper or copper alloy inside toward fresh circulating water.

In other applications, Red Brass, Aluminum Brass or Cupro Nickel to the water or steam side, and low carbon steel, nickel, lead, tin, etc., to the product side have been very satisfactory.

Many Products Handled

The list of possible products and their combinations that can be suitably handled by Duplex Tubing is virtually endless. The following are a few of the more common items:

Ammonia	Food Products
Amines	Formaldehyde
Beverages	Formic Acid
Boiler Water	Fruit Juices
Carbonated Liquids	Gums
Carbon Dioxide	Hydrogen Sulfide
Chemicals	Mercury
Coke By-Products	Nitric Acid
Cooling Water	Oils
Compressed Air	Petroleum Products
Cosmetics	Plastics
Drugs	Resins
Dyes	Refrigerants
Explosives	Soaps
Fatty Acids	Steam
Fertilizers	Sulfuric Acid
Flue Gases	Varnishes

Other Advantages

Aside from the unique advantage of custom-tailored corrosion resistance on both sides of your tubes, Duplex Tubes often give better impingement corrosion resistance, higher heat transfer rates, reduced fouling and slime, or higher operating temperatures, depending on the particular metal combination and operating conditions involved.

For example, careful heat transfer tests run on tubes of copper, steel, and copper/steel Duplex showed a higher heat transfer rate by far for the copper/steel Duplex than for the tube of steel alone. The tests also showed that in double wall tubes of the same material, there is virtually no reduction in heat transfer across the metal bond. This fact is the result of an excellent mechanical bond between the two concentric metals in Duplex Tubing, assured by Bridgeport's method of manufacture.

Installation Data

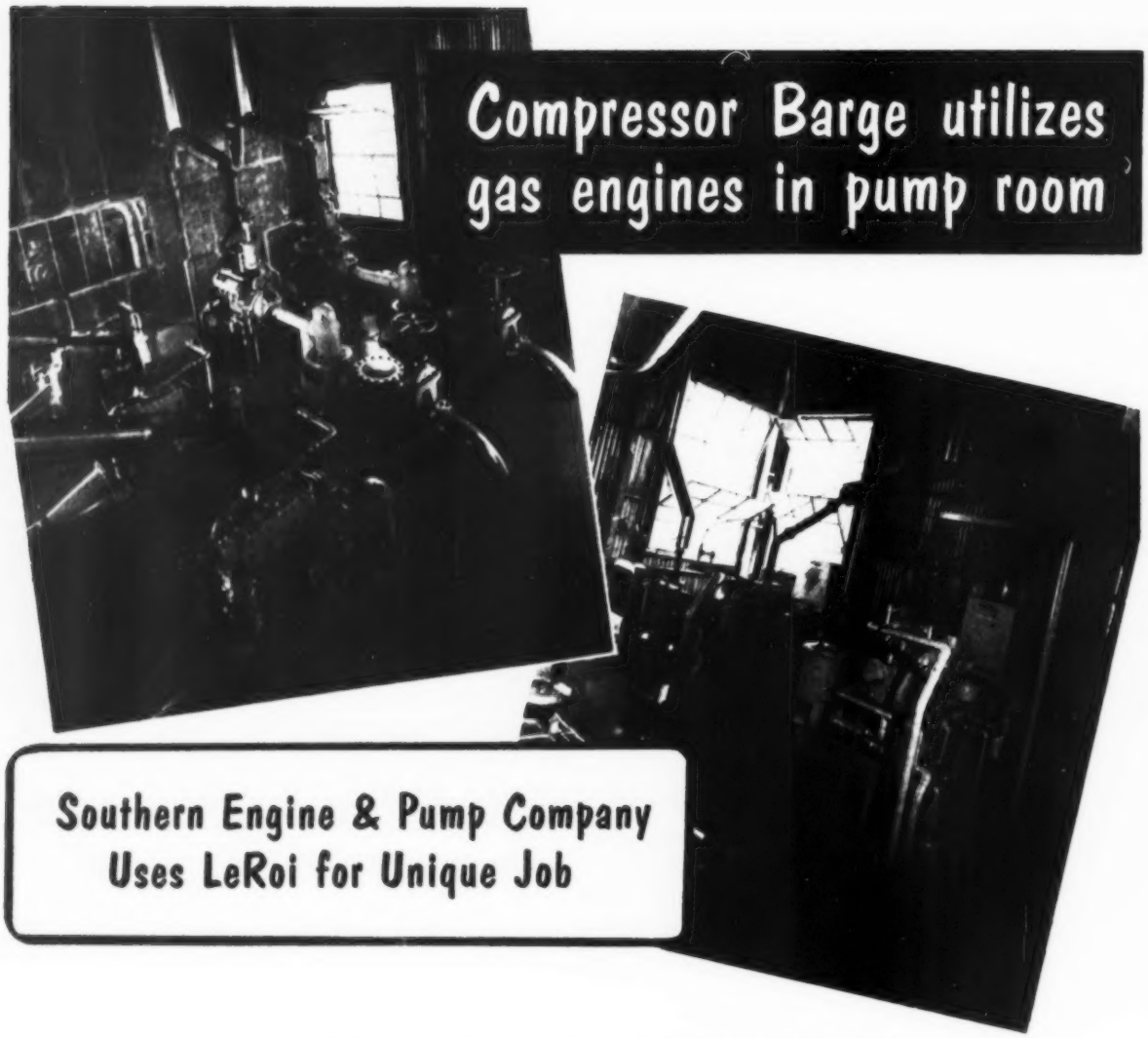
The *Duplex Tubes Technical Bulletin* also contains information on Selection of Proper Size and Gauge of Tubes, End-Annealed Tubes, Overcoming Galvanic Corrosion by Cutting Back Duplex Tubes, Bending and Joining Duplex Tubes, Provision for Thermal Expansion, and Provisions for Reducing Turbulence.

A complete section on methods of installation states that most combinations of Duplex Tubing can be expanded or rolled into the tube sheet in the same way as ordinary condenser or heat exchanger tubes, but offers precautions on several specific types. Detailed cutaway line drawings complete this presentation.

How to Get Your Copy

The Bridgeport *Duplex Tubes Technical Bulletin No. 1954* will be of valuable help in your double corrosion problems. Request your copy today on company letterhead. And for your condenser or heat exchanger tube requirements, or assistance on your corrosion problems, contact our nearest branch office. (1684)

For more data on advertised products, use Readers' Service Cards, last page.



Compressor Barge utilizes gas engines in pump room

Southern Engine & Pump Company Uses LeRoi for Unique Job

Careful consideration of the factors affecting operation of this large compressor barge located in South Louisiana bay waters belonging to one of the major oil companies led to the selection of the dependable LeRoi engines. Initial costs as well as operating costs were important items.

The illustration shows three LeRoi D-471 Engine Driven Jacket Water Pumps; two LeRoi H-540 Engine Vertical Raw Water Pumps; one LeRoi D-201 Engine Driven Air Compressor, and two LeRoi D-382 Engine Driven 20 KW Generator Sets. All units are hooked up with a common jacket water system.

Competent engineers, skilled mechanics, and friendly helpful service is always available to serve you.

SOUTHERN
ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS

Houston, Dallas, San Antonio, Kilgore, Edinburg,
Corpus Christi, Texas. Lafayette and New Orleans, La.

What's Happening. . .

purchased for $.25 from the Government Printing Office, Washington, D. C.

14 Colleges Receive Atlantic Scholarships

Fourteen universities and colleges have accepted The Atlantic Refining Company's offer of awards of 12 scholarships and 2 fellowships for the academic year beginning next September.

Purpose of the awards is to encourage and assist promising undergraduate and graduate students in studies in the fields of science, engineering and research directly related to petroleum industry operations.

Fellowships were accepted by Rice Institute, for chemical engineering, and Washington University, geology.

Accepting the scholarships were Alabama Polytechnic Institute, chemical engineering; Colorado School of Mines and St. Louis University, geophysics; Georgia Institute of Technology, electrical engineering; University of Kansas, Louisiana State University, Oklahoma University and Tulsa University, petroleum engineering; Southern Methodist University and the University of Texas, geology, and Texas A. & M. College and Texas Technological College, mechanical engineering.

Texaco Offers Cure For Ills of Modern Engine

The Texas Company has come up with its own solution to the problem of what gasolines need to meet the demand of today's high-compression automobile engines. The company has announced a petroleum-derived compound which is said to extend the life of an automobile engine. The petroleum-derived compound—as distinguished from an inorganic-derived chemical additive—is being catalytically manufactured in a new plant at Port Arthur, Texas. The new gasoline containing the compound is being put on sale this month.

ODM Reminds of Grants On Protective Instruction

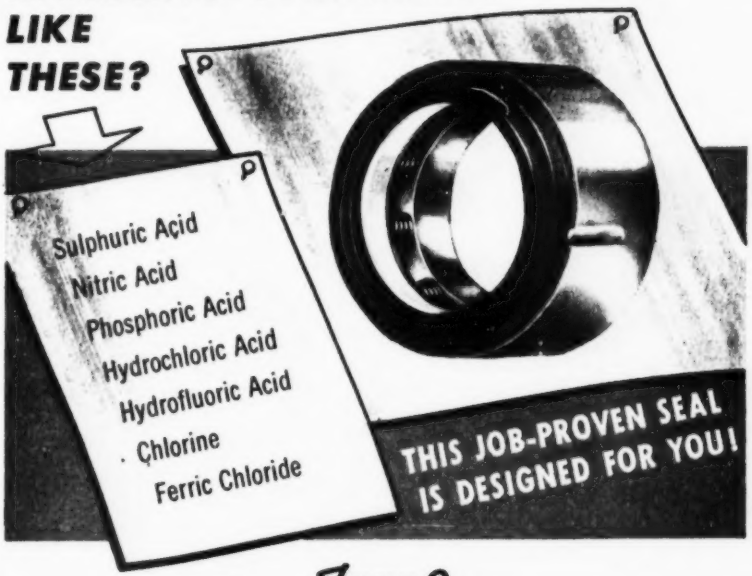
Private industry was reminded last month that rapid tax write-off is available for protective construction at industrial facilities which produce material for which an expansion goal has been set. In pointing this out, the Office of Defense Mobilization said it makes no difference if the goal is still open. Construction must be at such facilities as oil refineries, etc.

Such construction is required to meet Federal Civil Defense Administration standards. Typical construction: structural strengthening of buildings, special shelters for personnel and equipment and protection for plant services and utility systems, and installation of damage-resistant materials.

Billy Muir Dies at 102

William (Billy) Muir, one of the founders of the National Petroleum Association, died recently. He would have been 103 years old April 10. Muir was a

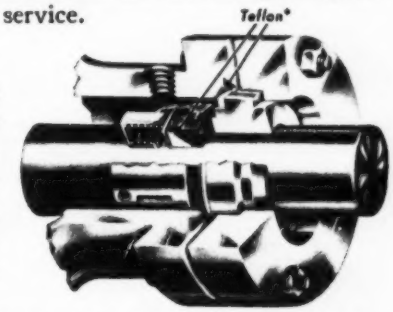
HANDLING CORROSIVES LIKE THESE?



JOHN CRANE *Type 9* **MECHANICAL SEAL**

Performance records plainly prove that this "John Crane" development has successfully solved the handling of the most difficult corrosive liquids and gases. Where conventional type seals had failed, the Type 9 has done the job. It continues to answer new problems, including temperature conditions from —120°F. up to 500°F.

Designed to withstand practically all chemicals, the Type 9 incorporates a flexible wedge ring and sealing ring molded from DuPont's Teflon. It is engineered for the particular application and can be furnished in the metallurgical specification best suited to the service.



Your toughest problem can be the Type 9's next success story. Use it on all rotating shaft applications, including: centrifugal, rotary pumps, mixers, agitators, autoclaves, other equipment.

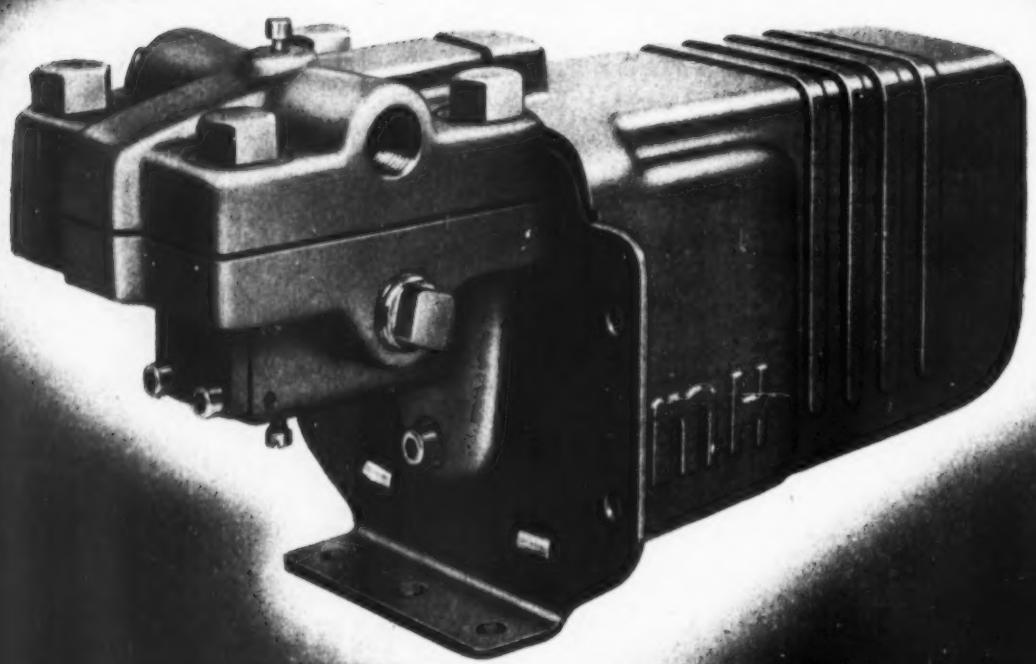
Get complete information on the Type 9 Seal from Crane Packing Co. 1820 Cuyler Ave., Chicago 13, Ill.

In Canada: *Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.*

*Du Pont trademark

JOHN CRANE CRANE PACKING COMPANY

For more data on advertised products, use Readers' Service Cards, last page.



compare these features!

simplicity:
uses no mercury; a rugged pneumatic balance transmitter, it has few moving parts . . . needs practically no maintenance.

wide range:
readily adjustable in the field for ranges from 0–20 to 0–200 inches of water.

simple calibration:
easily calibrated with weights . . . no curves or tables needed; 1 lb. equals 10" of water.

withstands overloads:
takes many times rated pressure without loss of accuracy or damage to working parts.

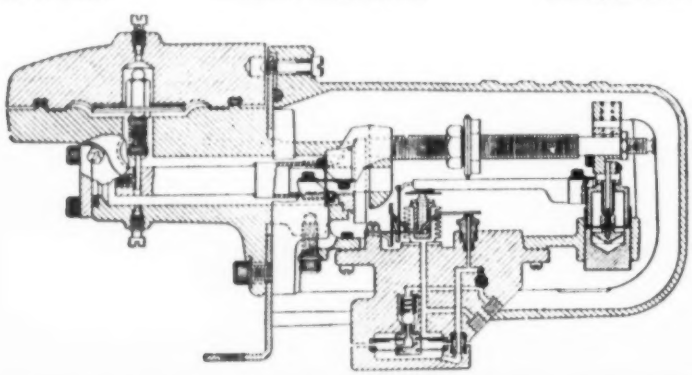
for use with miniature instruments:
converts pressure differential at the metering orifice into a proportional air pressure for transmission to remote indicators, recorders or controllers. The ideal companion for *Tel-O-Set* miniature instruments.

temperature range:
handles fluids at temperatures as high as 350° F.

versatility:
available with or without non-bleed pilot booster relay.

sensitivity:
responds rapidly to quick changes in flow.

easy installation:
lightweight, compact unit is readily mounted anywhere.



For flow measurements— the **HONEYWELL DIFFERENTIAL CONVERTER** *is better than ever*

NEW CONSTRUCTION features now make the Honeywell Differential Converter, more than ever, the standard of performance for remote measurements of flow and differential pressure.

It's more accurate than ever . . . has improved linearity of response. It's more stable, with a larger dashpot and heavier oil to smooth out spurious line fluctuations. And it's even more rugged . . . can take overloads of many times normal pressure without damage to the diaphragm or impairment of precision.

More than ten thousand Honeywell Differential Converters have been installed on an ever broadening variety of applications . . . on pipelines, in conjunction with graphic instrumentation, and in scores of other uses which need accurate, flexible remote transmission of measurements.

You can see what's behind this industry-wide acceptance, by checking the Differential Converter's outstanding features described on the opposite page. You can find out even more by testing it yourself, under any operating conditions your plant may present. And for a personal discussion of your individual process requirements, call your local Honeywell sales engineer . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Bulletin 2290, "Honeywell Differential Converters."**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

Built Specially for Pipeliners

SCHIELD Bantam handles TOUGH SHALE . . . ROCK . . .

Rough going, but C-35 Bantam Crawler keeps pipeline trenching on schedule.

Or is a real SWAMP WALKER . . .

There's plenty of traction and flotation in Schield Bantam's New C-35 Crawler. It's the finest walker on the market. C-35 has 2½ lbs. p. s. i. ground bearing pressure with 32" pads.

A PIPELINER'S RIG . . . *Check These Bantam Crawler Features*

2-Speed Independent Travel . . . hoist, swing, carry-the-load while traveling—all at the same time.

High-Speed Operation . . . C-35 features fast line and swing speeds, instant-acting straight mechanical controls.

Proper Balance . . . longer, wider crawler base—nearly square—has low center of gravity with adequate clearance.

Power Boom Hoist . . . for power lowering as well as raising, standard equipment, no extra cost.

LOW INITIAL COST -- LOW MAINTENANCE COST

Complete Line of Bantam-Built front-end attachments available for the C-35 Crawler. Find out more about how this new "pipeliner's dream" can speed-up your excavating and lifting jobs, and at the same time cut your costs. Ask your nearby Schield Bantam Distributor for a demonstration TODAY! Or write the factory—NOW!

Model T-35 with All-New Crane Carrier Lifts 12,000 Lbs.

SB-PR-1

SCHIELD Bantam®

COMPANY • 285 PARK ST., WAVERLY, IOWA, U. S. A.

What's Happening. . .

builder of one of the earliest refineries in Pennsylvania.

Purvin and Gertz Adds Robert Greene to Staff

Robert L. Greene, formerly process engineer with the Esso Engineering department of Standard Oil Development Company, has joined the staff of Purvin and Gertz, Consulting Engineers, Dallas, Texas. He will serve as a process consultant in the design and operation of facilities for the processing of oil and gas.

Greene

Greene received an M.S. degree in chemical engineering from Massachusetts Institute of Technology in 1947. At Standard Oil Development he was concerned with refinery process design and planning.

LP-Gas Promotional Group Elects James Pew Chairman

James E. Pew, manager of the Natural Gas and Natural Gasoline department, Sun Oil Company, has been elected chairman of the National Committee for LP-Gas Promotion. He succeeds Lee A. Brand, vice president, Empire Stove Company.

At the same time the organization:

- Adopted a new name—National Council for LP-Gas Promotion.
- Named K. R. D. Wolfe, vice president, Fisher Governor Company, chairman of a newly constituted executive committee.
- Elected Robert E. Borden, director of the LP-Gas Information Service who has been secretary of the national committee since its inception, secretary of the council.
- Discussed plans for an intensified drive for new contributors to the promotional program.
- Named E. Carl Sorby, vice president, Geo. D. Roper Corporation, who has been chairman of the copy subcommittee for several years, to the promotional council as a Gas Appliance Manufacturer Association representative.

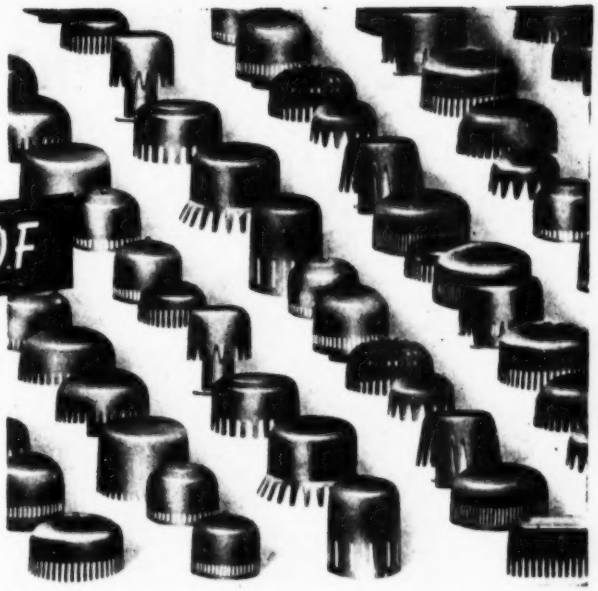
The new chairman, Pew, is a past president of the NGAA, one of the three trade organizations co-sponsoring the National LP-Gas Promotional Program. He received NGAA's Hanlon award in 1945.

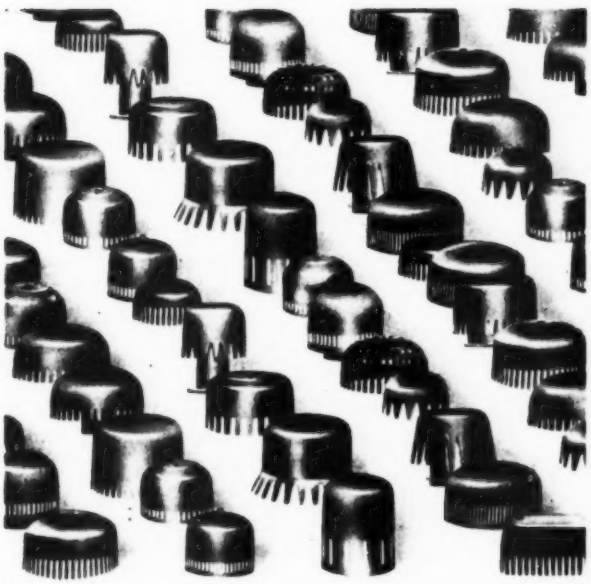
Richfield Honors Zweifel For Developing Sealer

Henry C. "Pat" Zweifel, supervisor of lubricating products development at Richfield Oil Corporation's Watson, Calif., refinery, was rewarded last month for making a new sealer and lubricant for pipe joints.

Zweifel received a $5000 check and congratulations from his superiors and fellow employes at a luncheon in his

300 STANDARD STYLES OF PSC Bubble Caps & Risers





...promptly furnished WITHOUT DIE COST

With dies on hand for over 300 standard styles of bubble caps and risers, PSC is in a position not only to save many customers the cost of dies but also to save them design and delivery time. PSC bubble caps are also effecting substantial maintenance economies, due to the fact that PSC customers can order bubble caps in the particular metal which best meets their specific heat and corrosion requirements. We fabricate caps from any metal: aluminum, brass, copper, nickel, stainless steel in any chrome-nickel or straight chrome type, as well as carbon steel.

You'll Be Days and Dollars Ahead with PSC Caps

PSC catalog 52 contains, we believe, the largest compilation of engineering data on bubble caps; also drawings for use in determining methods of tray assembly. Details in catalog can be modified in almost unlimited ways to suit your needs. Special caps made to order.

——*SEND FOR CATALOG 52*—▷

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

☆ ☆ ☆ OFFICES IN PRINCIPAL CITIES ☆ ☆ ☆

For more data on advertised products, use Readers' Service Cards, last page.

SOLVE YOUR MIXING PROBLEMS

A tremendous variety of fluid mixing needs are ably handled by the complete line of Eastern Mixers. Size and power of mixers are flexible to help solve your problems. For complete information and engineering data, write for Eastern Fluid Mixing Catalogs. Eastern engineers are always available to work out your complex mixing problems with you.

EASTERN INDUSTRIES ★ MIXER DIVISION ★

Eastern INDUSTRIES, INC.
Dept. C, Regent St., Norwalk, Conn.

What's Happening. . .

honor for developing a threadseal lubricant, patent rights on which have been assigned to Richfield.

Standard Oil Development Names Taff and Hakala

Appointment of Wilfred O. Taff and Neil V. Hakala as assistant directors in

Taff

Hakala

the Esso Laboratories has been announced by Standard Oil Development Company.

In his new capacity, Taff, who has been with the company since 1939, will be responsible for research and development on new fuel processes in the Laboratories' Process division. Hakala, who is in the company's Research division, will be responsible for research on automotive fuel quality and combustion problems on automotive engines.

Stone & Webster Elects Two New Vice Presidents

Alfred L. Hartridge and Stuart F. Kosters have been elected vice presidents and Thomas W. Barry appointed an assistant treasurer of Stone & Webster Engineering Corporation.

Hartridge has served in various capacities at Stone & Webster, including personnel manager and treasurer, at which latter post he continues. Kosters is appraisal manager as well as a new vice president. Barry has been chief accountant of the company since August, 1953.

A. Ludlow Clayden Dies

A. Ludlow Clayden, former head of Sun Oil Company's Automotive Laboratory at Marcus Hook, Pa., died recently in Halifax Hospital, Daytona Beach, Fla. He was 71.

An authority on fuels and internal combustion engines, Clayden retired last July after 31 years with Sun Oil Company.

California Oil Sets Up Scholarships at Rutgers

The California Oil Company, which operates a large refinery at Perth Amboy, N. J., has established three four-year scholarships at the Rutgers University for outstanding graduates of the three high schools serving that part of Middlesex County—Perth Amboy and Woodbridge public high schools and St. Mary's Parochial High School, Perth Amboy.

Each of the scholarships will provide $600 per year toward tuition and other expenses in the men's colleges here and

A major oil refining company on the eastern seaboard is building a catalytic reforming plant with capacity of 17,600 barrels per day....

. . . and PETROCHEM-ISOFLOW Furnaces will charge this 17,600 bpd plant.

A major oil refining company on the Texas gulf coast is building a catalytic reforming plant with capacity of 21,000 barrels per day....

PETROCHEM-ISOFLOW Furnaces

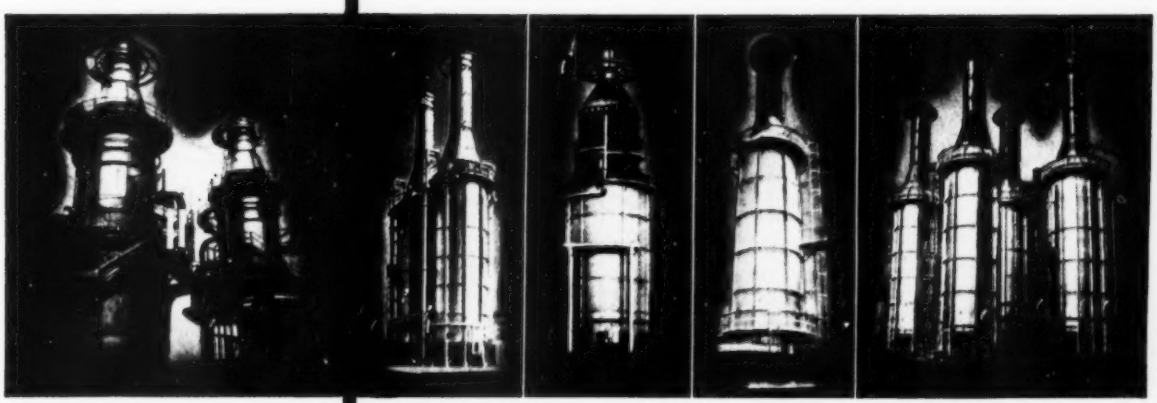
. . . and PETROCHEM-ISOFLOW Furnaces will charge this 21,000 bpd plant.

purchased for two of the largest cat reformers

Our first cat reformer heaters went into operation three years ago. Since then, we have sold catalytic reforming heaters for plants ranging from 1,000 barrels to 21,000 barrels per day. If you anticipate the installation of a catalytic reformer of any type, you will profit by investigating PETROCHEM-ISOFLOW heaters for this service.

More than 1150 Petrochem-Isoflow Furnaces are in operation throughout the world in the petroleum, chemical and allied industries . . . for all processes and for any duty, pressure, temperature and efficiency . . . and all

Petrochem-Isoflow Furnaces are most efficient by any comparison.



PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INC. • 122 East 42nd St., New York 17, N. Y.

Representatives: Bethlehem Supply, Tulsa and Houston • Flagg, Brackett & Durgin, Boston • D. D. Foster, Pittsburgh • Faville-Levally, Chicago • Lester Oberholtz, Los Angeles • Gordon B. Hardin, Louisville • Turbex Equipment Co., Narberth, Pa.

For more data on advertised products, use Readers' Service Cards, last page.

ALCOA ALUMINUM

SAVES MONEY

Alcoa Aluminum actually costs less than other corrosion-resistant metals. For example, Alcoa Heat Exchanger Tubes cost ½ the price of Admiralty, ⅔ the price of Mild Steel, ⅛ the price of Stainless. Alcoa Aluminum tank cars cost ⅓ less than stainless steel cars, and Alcoa Aluminum Coiled Tube costs up to 40 per cent less than copper.

HIGH HEAT CONDUCTIVITY

Aluminum (2S) has a thermal conductivity of 0.50 cgs units at 20° C, equivalent to 1,450 Btu per hour per square foot per inch of thickness per degree Fahrenheit. This high thermal conductivity is an advantage in the use of aluminum in equipment where efficient heat transfer is important.

RESISTS CORROSION

The high resistance of Alcoa Aluminum to attack by water, foods and many chemicals has led to the use of this metal in processing equipment of many kinds.

NONTOXIC

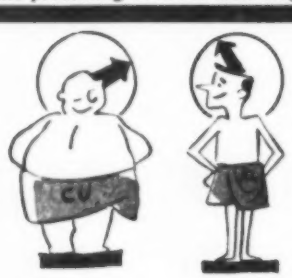
Alcoa Aluminum is resistant to attack by foods. Moreover, aluminum and its compounds are nontoxic. Aluminum equipment has found widespread use in the processing of foods and drugs.

WON'T "SPARK"

Because of its nonsparking characteristics, Alcoa Aluminum is used with explosives or inflammable materials. Combined with its other advantages, aluminum is ideal for powder plant machinery, ventilator fans in industrial plants, shovels in mines and chemical plants, and containers and tanks for gasoline, as well as chemicals.

EASY WORKABILITY

Manufacturers find aluminum easy to machine, shape, form, cast, roll, extrude, forge and assemble with standard tools and machinery. It can be joined by all methods of welding. Also certain alloys can be brazed.



LIGHT WEIGHT

Alcoa Aluminum drums and barrels, tank cars and trucks have the advantage of light weight, easier handling and more pay load.

GOOD PERFORMANCE AT LOW TEMPERATURES

Down to —320° F, Alcoa Aluminum actually improves 23 per cent in yield strength, 80 per cent in elongation, 67 per cent in tensile strength. Millions of pounds of aluminum are now in use for tonnage oxygen production, nitrogen removal, dewaxing, propane chilling, ethylene extraction and many other low temperature processes.

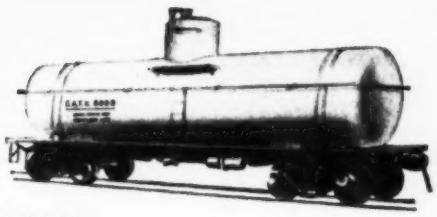
PROTECTS PRODUCT PURITY

Alcoa Aluminum will not discolor or harmfully contaminate products processed in it. It will not deteriorate lubricating oils nor form sludge or gum. Leading process engineers specify aluminum processing equipment for such compounds as acetic acid, naval stores and hydrogen peroxide.

is used in the Process Industries

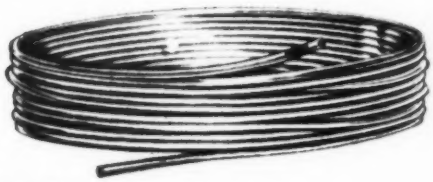
HEAT EXCHANGER TUBES

An average-sized refinery can save $50,000 in first cost by using Alcoa Aluminum Tubes. For details, write for our free booklet, *Alcoa Aluminum Heat Exchanger Tubes.*



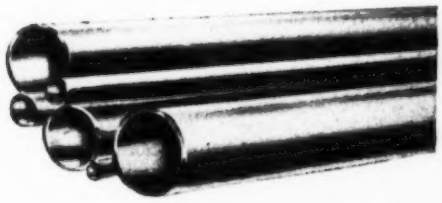
TANK CARS

Ask your car builder about the advantages of lightweight aluminum rolling stock. Or better still, write Alcoa. We have facts and figures on hundreds of liquid ladings that can be safely, economically shipped in aluminum.



COILED TUBE

Alcoa Utilitube® is made of a specially selected alloy providing easy workability and high fatigue strength. It's used for pneumatic control circuits, fuel lines, lubricating lines and hydraulic systems. For details, write for the free booklet, *Alcoa Utilitube.*



PIPE

Alcoa Aluminum Pipe and Fittings offer many advantages to the chemical, petroleum and food processing fields. Also used for oil, gas, water, compressed air and mine drainage pipe lines. Write for the booklet, *Alcoa Aluminum Pipe and Fittings.*

STORAGE TANKS

Purity of many chemicals is protected by storage in aluminum tanks, ranging in size from the very smallest to more than 200,000 gal. capacity. We'll gladly send you the names of reputable fabricators of aluminum storage tanks.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

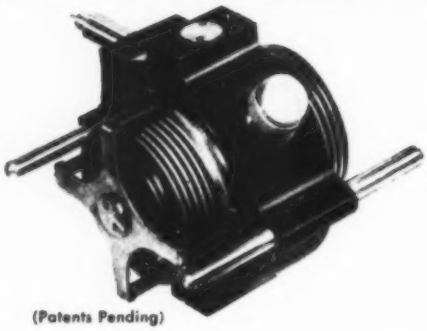
ALUMINUM COMPANY OF AMERICA
905-D Alcoa Building, Pittsburgh 19, Pa.
I would like more information on:

- ☐ Alcoa Heat Exchanger Tubes
- ☐ Alcoa Utilitube
- ☐ Alcoa Aluminum for Tank Cars
- ☐ Alcoa Aluminum Pipe
- ☐ Aluminum Storage Tank Fabricators

Name _____
Title _____
Company _____
Address _____

For more data on advertised products, use Readers' Service Cards, last page.

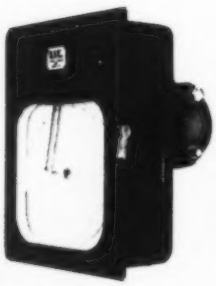
flow meters



(Patents Pending)

WITH FEATURES THAT MAKE A REAL DIFFERENCE IN SERVICE

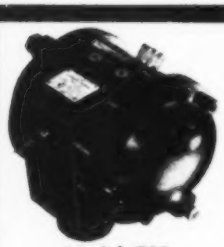
1. Greater power, longer-calibrated travel for assured accuracy.
2. One-piece seamless, type 316 stainless steel bellows. No pitting, no welds, longer life. (Monel bellows can be furnished for special services.)
3. An exclusive I.I.C. development, the patented free floating Non-Freezing Instrument Bearing, makes possible a new era in flow meter accuracy.
4. Differential obtained from actual displacement of fluid and not from stem movement.
5. Over-range protection to housing rating.
6. Pulsation may be dampened in service without special tools.
7. Complete compensation for wide range of ambient temperatures.
8. All standard ranges available: 0-10" H_2O to 0-300" H_2O.
9. Working pressures up to 5,000 psi.
10. No precise leveling required.
11. Self-draining. No seal pots required.



Model 802 Recorder
(Patents Pending)
IIC Model 802 Recording Flow Meter is actuated by Model 700 Meter Unit.
Simple installation. Built by experienced instrument men from a simple design, engineered for rugged duty.

Model 800 Indicator
(Patents Pending)
IIC Model 800 Indicator is actuated by Model 700 Meter Unit, is calibrated in same manner as Model 802 Recorder.

Model 800-6 Indicator
(Patents Pending)
IIC Model 800-6 Indicator is actuated by Model 700 Meter Unit. Standard 6" dials available in uniform, square root, as well as other special ranges.



Model 700 Meter Unit
(Patents Pending)
The new standard of quality for metering devices, the Model 700 Meter Unit is used by other instrument manufacturers to actuate their own differential pressure recorders, indicators, controllers and transmitters.

Write for Bulletin 56-B

INDUSTRIAL INSTRUMENT CORP.

BOX 1909 ODESSA, TEXAS

What's Happening. . .

will be tenable for the full four years of the college program.

Candidates must meet all the usual requirements for admission to the University. The Rutgers University Scholarship Committee will select the winners on the basis of nominations from scholarship committees in the three high schools.

Deep Rock Promotes Chesney to Vice President

Robert M. Chesney has been promoted to vice president, manufacturing, of Deep Rock Oil Corporation. He was formerly manager of the company's Cushing, Okla., refinery. His new duties will include not only the overseeing of refinery operations but also new administrative responsibilities and supervision of Deep Rock's pipe line operations.

Chesney

Operating headquarters of the company's Pipe Line department, with J. H. Tubbs as manager, will continue to be located in Tulsa.

Chesney has been associated with the oil industry in various capacities since 1934. He joined Deep Rock in July, 1951, as manager of its Cushing refinery.

Chemical Industry Vet Joins Staff of Lummus

The Lummus Company, New York, has announced the association of C. E. (Todd) Lightfoot with the firm.

Lightfoot

For the past 25 years, Lightfoot has been active in the chemical industry, in chemical economics, sales, marketing and consulting.

The Lummus Company serves as designing engineers and constructors for the petroleum and chemical industries.

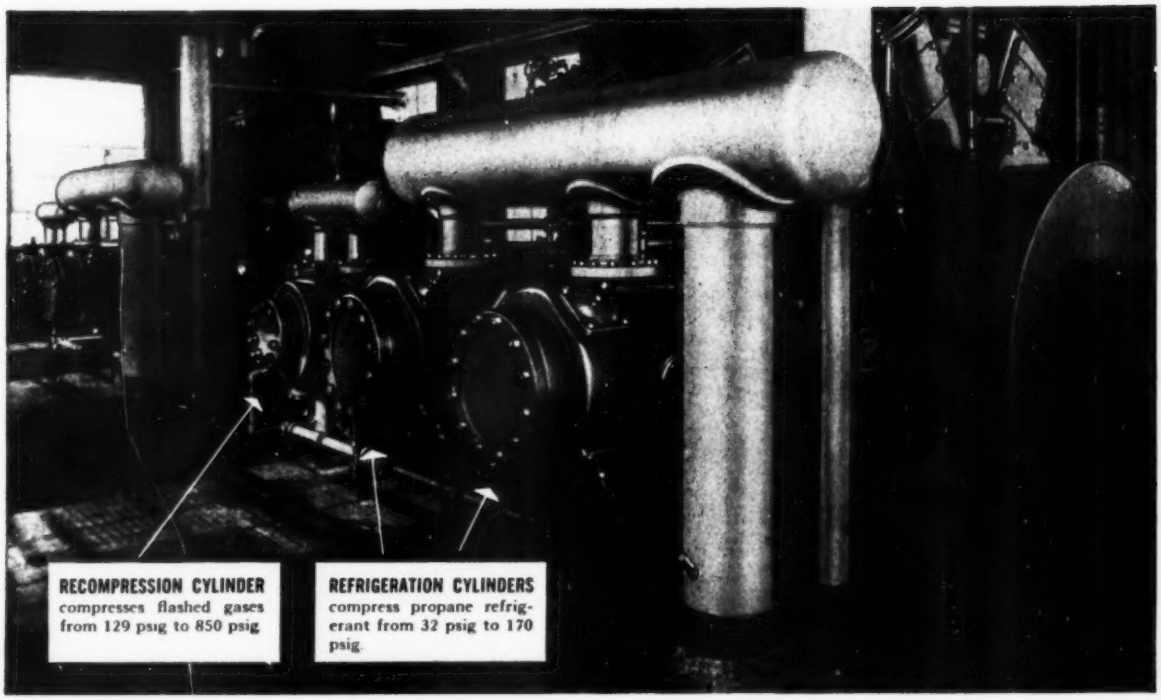
UOP and Union Offer Unifining Process

Universal Oil Products Company and Union Oil Company of California have announced that the Unifining process for the purification of petroleum distillates is now available to the petroleum refining industry. A refinery may secure the combined techniques and patent rights through a single license from either party.

Tide Water Plant Works Million Safe Man Hours

The 1450-man Avon, Calif., refinery of Tide Water Associated Oil Company has completed over a million consecutive man hours of work without a single

Unique Gasoline Plant designed for MINIMUM EXTRACTION


RECOMPRESSION CYLINDER
compresses flashed gases from 129 psig to 850 psig
REFRIGERATION CYLINDERS
compress propane refrigerant from 32 psig to 170 psig.

I-R SVG Compressors do double-duty at Northern Natural Gas Company's Gas Refrigeration Plant

THE primary purpose of Northern Natural's gas refrigeration plant at Holcomb, Kansas, is to extract only enough gasoline from the natural gas to prevent condensation in the transmission line. Pentane content is too low to justify the cost of a conventional absorption and distillation system. And heating value must be kept as high as possible.

These problems were effectively solved by refrigerating the gas to pipe-line temperatures, removing the condensate, and returning the flashed gas, under pressure, to the distribution line. While producing about 20,000 gallons of gasoline per day, this plant maintains maximum heating value of the gas and prevents loss of pipe-line efficiency due to hydrocarbon condensate.

Power for both refrigeration and recompression is provided by two Ingersoll-Rand 6SVG gas-engine-driven compressors. Two cylinders on each unit compress propane for refrigeration. The third cylinder recompresses the high btu vapors from the flash tanks for mixing with the outgoing gas.

This is just one example of the many instances where Ingersoll-Rand gas engine compressors have helped to solve a difficult problem simply and economically. Perhaps your process could benefit also. Why not let your I-R representative help you in planning and selecting the equipment for your new or remodeled plant.

Ingersoll-Rand

6-44 11 Broadway, New York 4, N. Y.

COMPRESSORS • TURBO BLOWERS • CENTRIFUGAL PUMPS
VACUUM EQUIPMENT • ROCK DRILLS • AIR TOOLS

THE COMPLETE LINE OF INGERSOLL-RAND GAS-ENGINE COMPRESSORS . . . the JVG in 110,165 and 220-hp sizes; the SVG in 330,440 and 550-hp sizes; the KVG in 660, 880, 1100 and 1320-hp sizes; the Turbocharged 2000-hp KVS.

For more data on advertised products, use Readers' Service Cards, last page.

Why **dbpc** antioxidant is 1st choice for Petroleum Products

motor fuels

aviation fuels

jet fuels

turbine oils

cutting oils

hydraulic oils

● **dbpc** (di-tert-butyl-para-cresol) offers you manifold advantages.

First of all, this Koppers antioxidant gives the highest possible protection against oxidation in petroleum products at very low cost. For example, in motor gasoline protection normally amounts to *less than one hundredth of a cent per gallon.*

Secondly, the versatility of **dbpc** warrants its use in a wide variety of petroleum products. The U. S. Government has approved **dbpc** as an inhibitor for aviation gasoline and jet fuels. It is widely used in motor gasolines, greases, lubricating oils, turbine oils, specialty oils, including cutting, spindle, and hydraulic oils, and many other oils where oxidation is a problem.

dbpc will not form deposits in carburetor fuel induction systems. It prevents the formation of gum in gasoline over long storage periods and will not impart color to the gasoline.

dbpc is safe to handle—non-toxic and non-irritating. Moreover, it is available in solid or solution form—called "Impruvol 33".

"dbpc" is only one of the many synthetic chemicals produced by Koppers. Others include Resorcinol, Styrene Monomer, Polystyrene, Phthalic Anhydride, and Divinylbenzene.

KOPPERS COMPANY, INC.
Chemical Division, Dept. PR-44, Pittsburgh 19, Pennsylvania

KOPPERS ®

Koppers Chemicals

SALES OFFICES: NEW YORK • BOSTON • PHILADELPHIA • ATLANTA
CHICAGO • DETROIT • LOS ANGELES

What's Happening. . .

disabling injury. This is the third time the refinery has passed the million-hour mark without a disabling injury.

Ethyl Gives $40,000 For Fellowship Program

Continuing its graduate fellowship program, Ethyl Corporation will support fellowships in 21 universities in the fields of chemistry, chemical engineering, mechanical engineering and physics for the academic year 1953-54. A total of $40,000 has been contributed for this purpose to cover stipends, tuition and fees. This is in addition to special research projects which are supported at a number of universities.

Institutions in the Ethyl fellowship program this year, by subjects selected for research, are:

Mechanical engineering: California Institute of Technology, Massachusetts Institute of Technology, University of Michigan, University of Wisconsin.

Chemistry: University of California, Harvard University, Iowa State University, University of Minnesota, Purdue University, Rice Institute, Wayne University.

Chemical engineering: Cornell University, University of Illinois, University of Delaware, Iowa State College of Agriculture and Mechanical Arts, Louisiana State University, Ohio State University, Princeton University, University of Texas, University of Tulsa.

Physics: University of Oklahoma.

Candidates in their final year of study for a doctor's degree are given preference but awards are also supported for other graduate students.

Royal Dutch Shell Firm Discounts Sabotage Rumor

Immediately after the second large fire to occur in 36 hours at the Pernis refinery operated by the Royal Dutch Shell Group, police were investigating possibilities of sabotage. However, N. V. De Bataafsche Petroleum Maatschappij, which operates the refinery, discounted all possibilities following a brief investigation. Operation of the large refinery was not disrupted by the blaze.

Cities Service Advances Two in Public Relations

John H. Purnell has been appointed director of public relations for Cities Service Oil Company. He has been in charge of publications and news since he joined the company in 1951.

John Steiger, editor of *Empire* magazine, the company publication, will be superintendent of publications and news in the Public Relations department.

Socal Chairman Dies

Carl A. Johnson, chairman of the board of Socal Oil & Refining Company, died recently at Pasadena, Calif. He was 76.

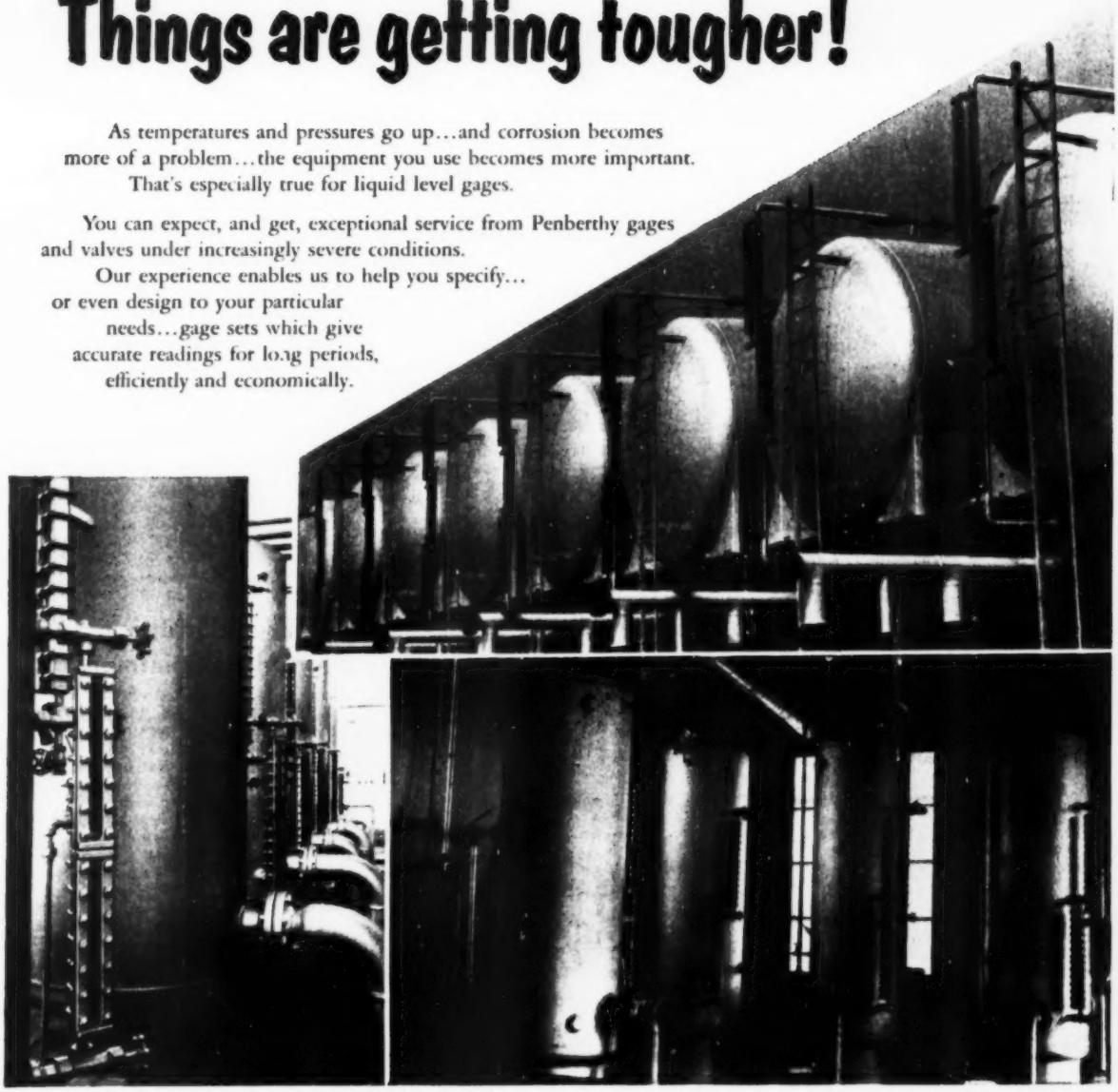
Besides his Socal post, he was president of Holly Development Company and immediate past president of the In-

Things are getting tougher!

As temperatures and pressures go up...and corrosion becomes more of a problem...the equipment you use becomes more important. That's especially true for liquid level gages.

You can expect, and get, exceptional service from Penberthy gages and valves under increasingly severe conditions.

Our experience enables us to help you specify... or even design to your particular needs...gage sets which give accurate readings for long periods, efficiently and economically.



● *To help you in specifying the right gages for your needs, write for Catalog 35. If your requirements are special, put our engineers to work on them.*

PENBERTHY INJECTOR COMPANY
Division of the Buffalo-Eclipse Corporation
1242 Holden Avenue • Detroit 2, Michigan
Established 1866

Penberthy gage sets are made from carbon, chrome-moly and stainless steel as well as Monel metal. They are also available in acid bronze, Everdur, nickel and Hastelloy. All materials conform to or exceed requirements for maximum recommended pressures and temperatures. The finished products are rigidly inspected and tested under actual working conditions.

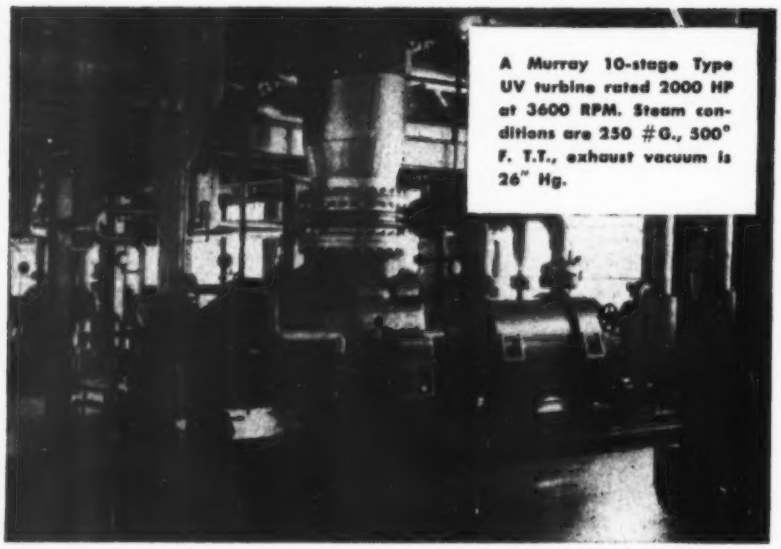
And, only with Penberthy Gages, do you get such features as the "Floating Shank" which automatically compensates for as much as 1/8" variation in center-to-center distance of the vessel tapping.

***There's Certain satisfaction in* PRODUCTS BY PENBERTHY**

- CYCLING JET PUMPS
- EJECTORS
- INJECTORS
- ELECTRIC SUMP PUMPS
- EDUCTORS
- EXHAUSTERS
- SYPHONS

For more data on advertised products, use Readers' Service Cards, last page.

Murray Turbines



A Murray 10-stage Type UV turbine rated 2000 HP at 3600 RPM. Steam conditions are 250 #G., 500° F. T.T., exhaust vacuum is 26" Hg.

● The Murray Type UV turbine pictured above has been driving a high pressure lean oil pump in a Southwestern refinery for the past 10 years. And is still giving dependable, trouble-free service.

Murray mechanical drive turbines both single and multi-stage can be furnished in a wide range of ratings for steam pressures ranging from 0 to 600 #G., condensing and non-condensing. Types in the higher pressures available for up to 250 #G. back pressure.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

What's Happening. . .

dependent Refiners Association of California, a director of IRAC, and a director of Western Oil & Gas Association.

Three Get Advancements At Reilly Tar & Chemical

Dr. H. A. Persyn has been appointed superintendent of the Fine Chemicals plant of Reilly Tar & Chemical Corporation. Dr. Persyn joined Reilly in 1936 and was formerly superintendent of Reilly's Newark, N. J., plant and, more recently, has been in charge of the Indianapolis refinery.

T. E. Courtney has been put in charge of Reilly's new synthetic pyridine plant. With Reilly since 1929, Courtney was formerly in charge of the Fine Chemicals plant.

Dr. W. R. Wheeler, who not only carried out the developmental work on the pyridine plant but also put it on stream, and was responsible for its operations for the first nine months, is now back with the Research and Development division. He is assistant director in charge of the Development department.

Naylor and Huffman Get Sun Oil Appointments

In appointments at Sun Oil Company's Marcus Hook, Pa., refinery, C. Calvin Naylor has become assistant to W. T. Askew, refinery manager, and Walter C. Huffman has assumed duties as assistant superintendent in charge of petrochemicals.

Naylor formerly served as operating assistant in the Catalytic, Gas and Alkylation division. Huffman was formerly general foreman of the company's petrochemical Plant 17.

Named to the post of operating assistant in the Catalytic, Gas and Alkylation division to replace Naylor is William J. Devonshire, Jr., formerly general foreman at Sun's Plant 16. Succeeding Huffman as general foreman at the petrochemical Plant 17 is Calvin Stubbs, formerly supervisory foreman there.

Sun Oil Moves Smith to Refinery Personnel Post

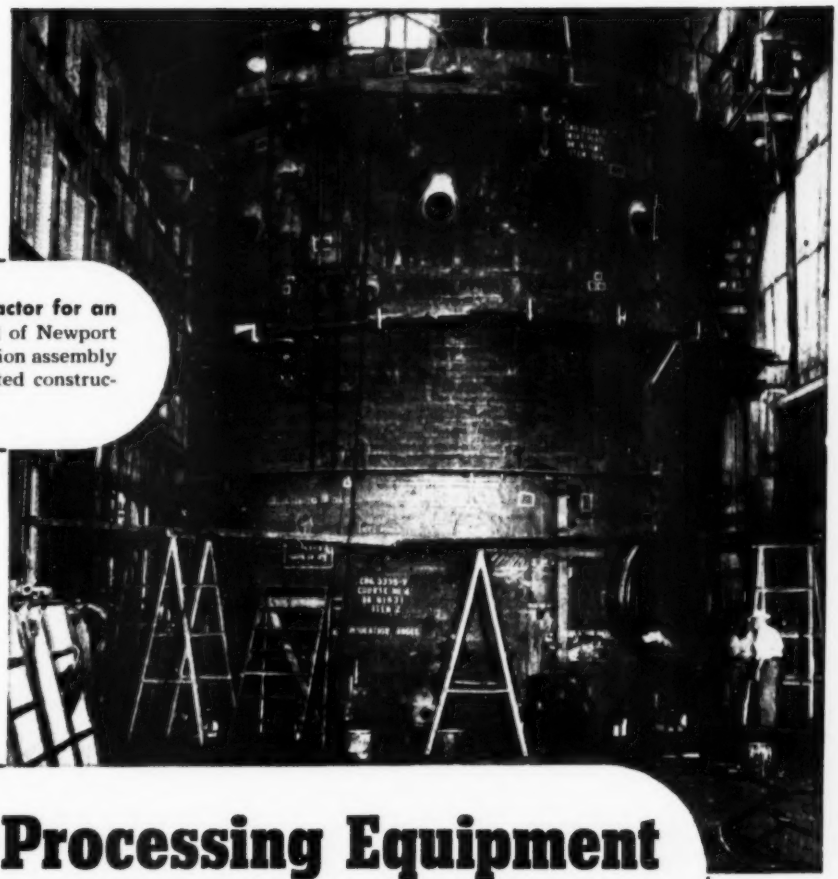
Harry G. Smith, special assistant to Sun Oil Company's director of industrial relations, has been appointed assistant superintendent in charge of personnel at Sun's Marcus Hook, Pa., refinery.

Smith first became associated with Sun when he took a summer assignment as assistant labor relations coordinator at the Marcus Hook refinery in 1949, while a professor of economics at Bucknell University.

Tanker Being Refitted for Shipment of Petrochemicals

The Standard Oil Company of California tanker *R. G. Follis* is to be refitted with special equipment to facilitate shipment of petrochemicals marketed through the Standard subsidiary, Oronite Chemical Company.

Principal alterations will take place



Course number four of a reactor for an overseas oil refinery. Typical of Newport News plant methods, the precision assembly of this unit in the shop expedited construction of the reactor in the field.

Petroleum Processing Equipment

...Built by Specialists in Metal Fabrication

Careful attention to detail characterizes the work of Newport News craftsmen...

They've fabricated millions of tons of steel including corrosion-resistant alloy, clad and other special steels for many diverse industries.

Newport News handles the job exactly as you want it done, for maximum results per dollar invested.

Specialized production techniques, advanced plant methods and a complete range of facilities along with many special purpose machines contribute to the excellence of Newport News fabrication.

Let us bid on equipment for your present or future projects. Learn how Newport News can help you...send for our booklet entitled "Facilities and Products." It's yours for the asking.

Newport News Shipbuilding and Dry Dock Company

Newport News, Virginia

For more data on advertised products, use Readers' Service Cards, last page.

BALDWIN-HILL

No. 1 INSULATIN CEMENT

HOT
COLD

This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS 117-49 as issued by U.S. DEPARTMENT of COMMERCE

CERTIFIED BY MANUFACTURER No. 100

In cooperation with INDUSTRIAL MINERAL FIBER INSTITUTE, INC.

Where you require a highly effective, plastic insulation to be applied easily and economically . . . B-H No. 1 CEMENT is your answer. It is particularly adaptable for insulating ducts, breechings, valves and piping not suited to molded types of insulation. Effective up to 1800°F., B-H No. 1 has exceptionally low thermal conductivity. It also provides an economical advantage in its reclaimability where temperatures have not exceeded 1200°F. It can be remixed with water and used again without loss of efficiency. And a rust inhibitor prevents corrosion of steel surfaces covered by B-H No. 1 CEMENT. For more complete information, get in touch with B-H Engineered Insulation Service—and send the coupon below.

Baldwin-Hill

Clip on signed letterhead and mail

TEAR OUT

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Please send complete information on

- ☐ **No. 1 INSULATING CEMENT** . . . All purpose, rust-inhibiting, plastic cement
- ☐ **MONO-BLOCK** . . . Rigid, felted rockwool block—for high and low temperature use
- ☐ **POWERHOUSE CEMENT** . . . High adhesion, rockwool, insulating-finishing cement
- ☐ **BLANKETS** . . . Metal reinforced, flexible, felted, rockwool insulation

What's Happening. . .

in the main tanks. Installation of the new equipment is now taking place in San Francisco during the vessel's regular annual overhaul.

Caltex Makes Singleton Executive Vice President

A. J. Singleton has been elected executive vice president of California Texas Oil Company, Ltd.

Singleton

Singleton's career in the oil industry began in 1924 with Galena Signal Oil Company (of Ireland), Ltd. Two years after that company was acquired by The Texas Company in 1929, he was appointed managing director of The Texas Company's English subsidiary in London. When The Texas Company's European interests were acquired by California Texas Oil in 1947 he was made assistant vice president of Caltex. His most recent position was vice president and director of the Caltex Group.

NPC Status Will Remain Unchanged; PAD to End

Chances are that the National Petroleum Council will not be altered and the Petroleum Administration for Defense will be terminated early this month. Such were the reports which came out of the recent 1954 organization meeting of NPC, which unanimously chose Walter S. Hallanan, Petroleum Oil Company, to head the council for the eighth straight year and reelected R. G. Follis, Standard Oil Company of California, vice chairman.

Hallanan indicated that the Interior Department has become convinced of NPC's worth to the government and "wishes it to continue as a fully independent advisory group." He said Interior Secretary McKay has given "very emphatic support to the council as presently constituted."

On the PAD matter, PAD officials have reported to NPC that it needs only to finish up a "few administrative chores" before it can be terminated and its responsibilities switched to the Oil and Gas Division in the Interior Department.

Other developments of the meeting:

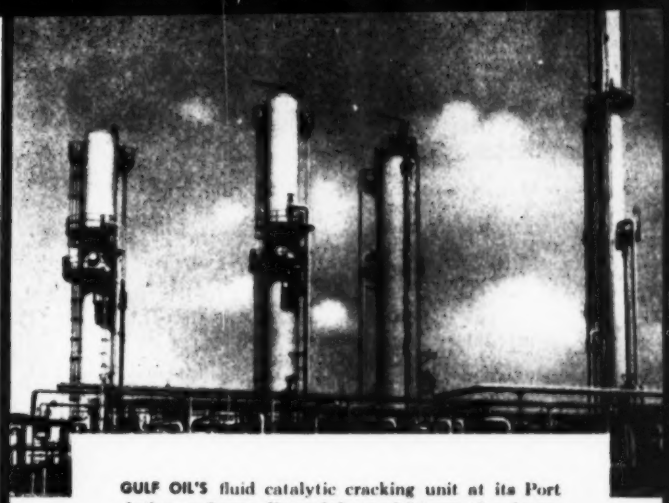
NPC approved a recommendation to launch government-requested studies on 1) petroleum storage capacity (including underground), and 2) the use of radio and radar in the oil and gas industries.

NPC got a budget of $85,000 for 1954.

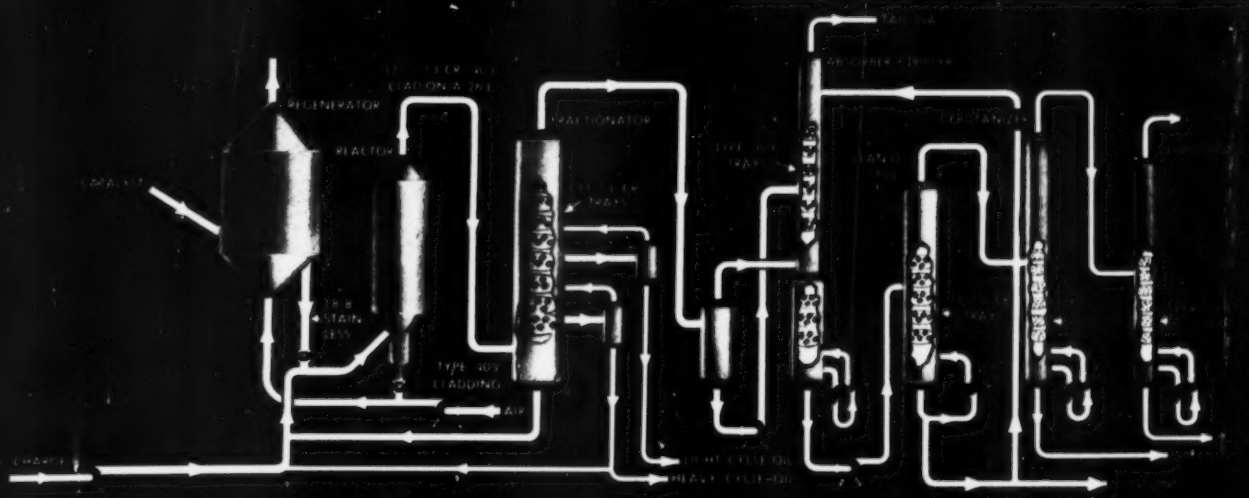
Shell Ahead of Schedule In Air Pollution Fight

Shell Oil Company has announced its air pollution control program is well ahead of schedule on an over-all basis. The company's total expenditure for this work to date, either spent or con-

HOW GULF USES STAINLESS STEEL in a fluid catalytic cracking unit



GULF OIL'S fluid catalytic cracking unit at its Port Arthur refinery. From left to right are the depropanizer, the debutanizer, the lean oil still and the absorber stripper.



THE fluid catalytic cracking unit diagrammed here was built in 1951 for the Gulf Oil Corporation's Port Arthur, Tex., refinery. With the help of Stainless Steel—used extensively in trays and piping—this unit handles 65,000 barrels of prepared charging stock daily.

The flow chart shows the various grades of Stainless used in different parts of the unit. Trays in the absorber stripper are Type 304 Stainless Steel, while tray plates in the debutanizer and in the depropanizer are Type 316.

Such careful selection of grades is extremely important in obtaining the maximum corrosion resistance and long life from Stainless Steel. Properly applied, Stainless Steel is one of the most important tools you can use in keeping your refinery operations on stream at all times.

Our new book, "Performance of Stainless Steels in Petroleum Refinery Service," contains much valuable data on properties of various grades. If you do not have a copy, mail the coupon below. And our representatives are always available to assist you in the selection of the right grade of perfected, service-tested USS Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · NATIONAL TUBE DIVISION, PITTSBURGH
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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS STAINLESS STEEL

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4-685

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Please send me my copy of "Performance of Stainless Steel in Petroleum Refinery Service."

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What's Happening. . .

tracted for, exceeds $2.5 million. Planned expenditures for the next 12 months will bring this figure to well over $3.5 million. These expenditures have been directed toward control of hydrocarbon emissions, elimination of odors, and control of dust, smoke and sulfur dioxide.

In addition to these expenditures for physical equipment and installation at its refineries, Shell, along with others in the industry, is continuing to make large contributions to independent research projects in this field.

Standard Oil Development Announces Four Changes

A series of organizational changes have been announced by Standard Oil Development Company. They are:

- Donald L. Campbell, formerly chief process engineer of the Esso Engineering department, appointed associate director of the Process division.
- Burton C. Belden, formerly an assistant director of the Process division, appointed chief process engineer in the Esso Engineering department.
- R. S. Piroomov, formerly manager of the Technical Service division, East Coast Manufacturing, Esso Standard Oil Company, named an assistant director of the Process division.

Meanwhile, F. William Schumacher, formerly associate director of the Process division, was appointed manager of the Technical Service division of Esso Standard Oil Company's East Coast Manufacturing division.

WHO'S BUILDING

Continued from page 195

2126 barrels a day of LPG from 67,000 Mmcf a day of wet separator gas, preparation of residual dry gas for sale, and delivery of LPG mixture to the Maysville natural gas plant for fractionation into propane, butane and natural gasoline, $2,271,340: $1,458,844 at 65 percent and $814,496 at 40 percent.

Stanolind Oil & Gas Company—Andrews County, Texas, natural gasoline plant to process 10 Mmcf a day of natural gas into 935 barrels a day of LPG products, and an 11-mile products line to its North Crowden plant, $1,964,500: $1,337,500 at 65 percent; $485,000 at 40 percent, and $142,000 at 25 percent.

Hancock Oil Company—Long Beach, Calif., 6000-barrel-a-day fluid coking unit at its Long Beach refinery to produce gasoline, catalytic cracker charge stocks and coke from residual oil, $1,814,800: $1,389,360 for basic refining facilities at 65 percent, and $425,440 for auxiliary facilities at 45 percent.

Skelly Oil Company—Eldorado, Kan., 7500-barrel-a-day catalytic reforming unit and related facilities at the Eldorado refinery to produce 100/130 aviation fuel base stock, aromatic concentrates and/or 95 octane gasoline, $1,800,000: $1,565,000 for basic refining facilities at 65 percent, and $235,000 for auxiliary facilities at 40 percent.

Union Oil Company—Wilmington, Calif., rehabilitation of a vapor phase butane isomerization plant in the Wilmington refinery to produce 1540 barrels a day of isobutane to be used as feedstocks for existing alkylate unit, $1,375,000 at 100 percent.

Fletcher Oil Company—Wilmington, Calif., 2500-barrel-a-day catalytic reforming unit to produce high octane fuels from low octane fuels and naphthas at its Wilmington refinery, $910,000: $703,710 at 65 percent, and $106,290 at 40 percent.

Gulf Oil Corporation—Runnels County, Texas, facilities to process 5 Mmcf a day of natural gas into 155 barrels a day of natural gasoline, 238 barrels a day of LPG products and 4 Mmcf a day of residue fuel gas, $400,000: $372,000 at 65 percent, and $28,000 at 40 percent.

Ohio Standard to Build Underground Storage

Construction of underground storage facilities for liquid propane and butane gases is planned by The Standard Oil Company (Ohio) at its Lima, Ohio, refinery. To cost $335,000, the project will include a central shaft 12 by 12 feet in diameter and 455 feet deep and two caverns 120 feet long by 50 feet high and 30 feet wide. The project is expected to be completed in October.

Gulf Oil Building Natural Gasoline Plant

Construction of a new semi-portable natural gasoline plant, has been started by Gulf Oil Corporation in Sueise field, Runnels County, West Texas. The plant will have a maximum capacity of 5

for the Petroleum Industry

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expert workmanship throughout, from

office force to delivery, has made

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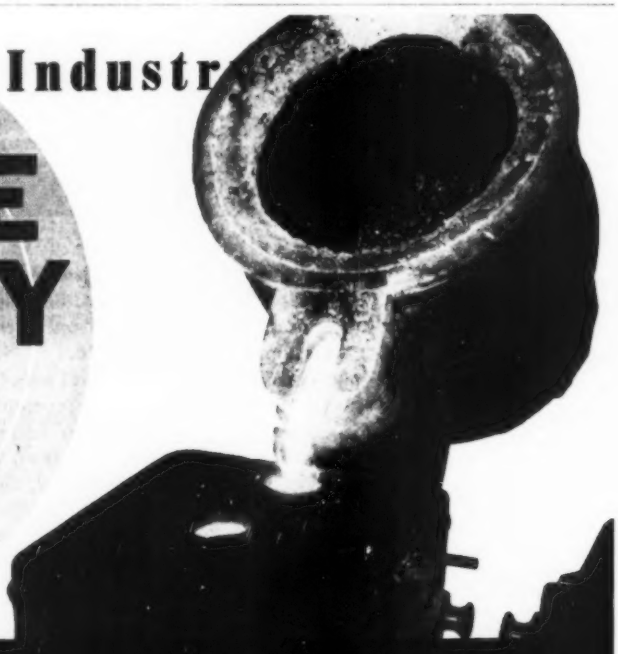

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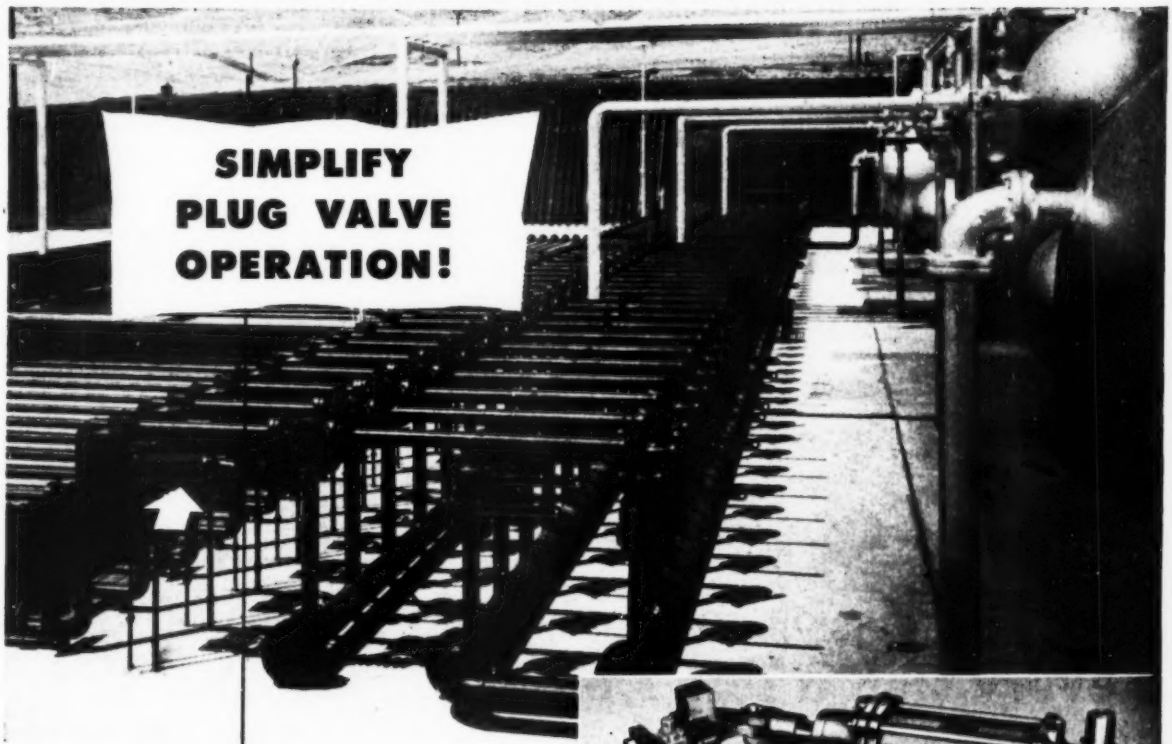

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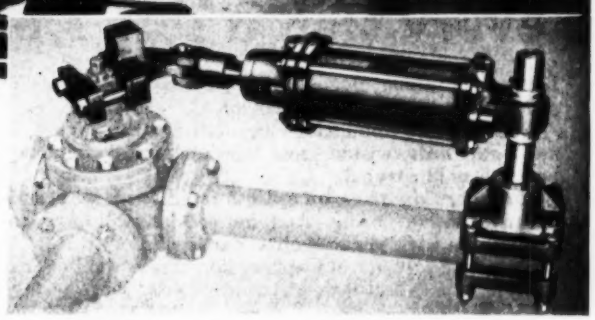
Fluid Power

Valve Operators

Hanna's new, low-cost packaged Plug Valve Operator power operates two-position, quarter-turn rotary plug valves. Because these compact units can be installed anywhere and in limited space areas, they eliminate manual control, reduce costly operating time. No more ladder climbing, long distance walking, wall scaling or disturbing flooring to turn valves on and off. With the new Hanna Fluid Power Plug Valve Operator, control is quick, convenient effortless. Installation is likewise simple. No special tools are required. A Hanna Engineer will be glad to show you how this new departure in valve operation can be adapted to your needs with profit.



The adaptability of the new Hanna Plug Valve Operator is shown in this application of a battery of Hanna units installed on Shell Oil Company's Brea Tank Farm in California.

The inset photo shows in bold outline the Hanna Valve Operator in a typical application.

- **Eliminates manual operation**
- **Provides dependable, positive control**
- **Saves costly operating time**

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Ready to install—no special tools needed.
Operates valves ranging in size from 1" to 12".
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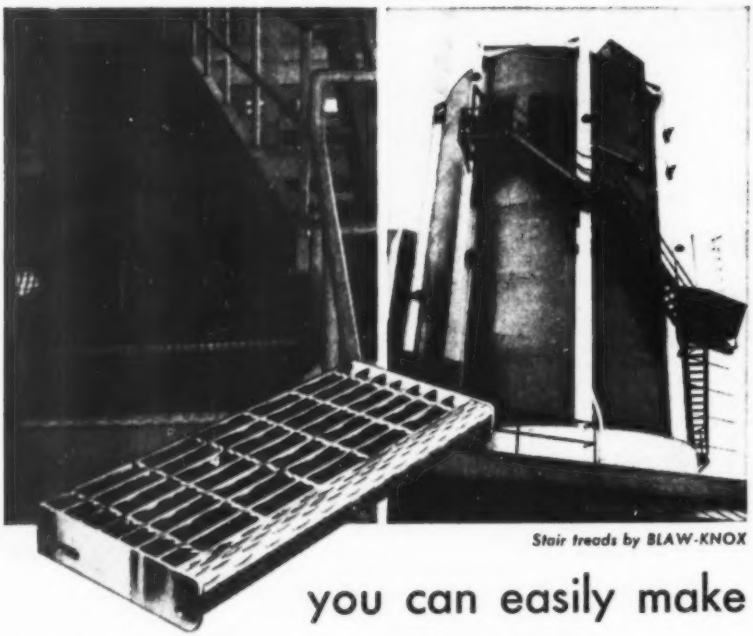
For more data on advertised products, use Readers' Service Cards, last page.



Stair treads by BLAW-KNOX

you can easily make

every step a safe step

Indoor or outdoor, you can rely on Blaw-Knox Stair Treads to provide the safety you want in your plant.

Designed for tremendous strength against impact, these stair treads are made with twisted cross bars and rolled diamond checkered plate nosing—as illustrated.

But, when desired, you can get treads with a twisted cross bar nosing or an abrasive nosing. And for specially slippery conditions we can supply you with serrated cross bar treads.

Just tell us what your application is and we'll offer our recommendations as to the best type of tread for your job.

Only Blaw-Knox Electroforged*® *Steel Grating and Stair Treads —have these five exclusive features:

1. rigid one-piece construction—easy to install
2. all surfaces accessible—easy to paint
3. no sharp corners to clog—self-cleaning
4. maximum open area—for light and ventilation
5. non-slip twisted crossbar—safe footing

A short note will bring you a copy of new Bulletin No. 2365-R —a dimensional sketch will bring you a quotation.

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BLAW-KNOX EQUIPMENT DIVISION
GRATING DEPARTMENT

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.

Who's Building . . .

Mmcf of casinghead gas a day. It will be an oil-absorption type, producing natural gasoline and a butane-propane mix.

Two 550-hp. units, mounted together with the rest of the plant on skids, compose the compression facilities.

Bids Being Readied on Great Northern Refinery

Five contractors are preparing bids on the construction of the proposed completed refinery which Great Northern Oil Company will build at St. Paul, Minn. The bidding firms are: The Fluor Corporation, Ltd., Los Angeles; Bechtel Corporation, San Francisco; The Refinery Engineering Company, Tulsa; Blaw-Knox Company, Tulsa, and The Lummus Company, New York.

The bids are to be submitted early in May. The contract will probably be let the latter part of that month.

The proposed refinery will include a crude unit, coking unit, TCC catalytic cracking unit as licensed by Socony-Vacuum Oil Company, hydrodesulfurization and ultraforming units as licensed by Standard Oil Company (Indiana), catalytic polymerization unit as licensed by Universal Oil Products Company, gas recovery plant, treating unit, steam generation plant and tankage.

Pure Building New Type Cat Reformer at Newark

A completely new type of catalytic reformer is taking shape at The Pure Oil Company's Heath refinery at Newark, Ohio. Designed and being erected by The M. W. Kellogg Company, the reformer represents the first commercial installation of the special process developed by Kellogg to utilize the new regenerative platinum catalyst, RD-150. Kellogg is a subsidiary of Pullman, Inc.

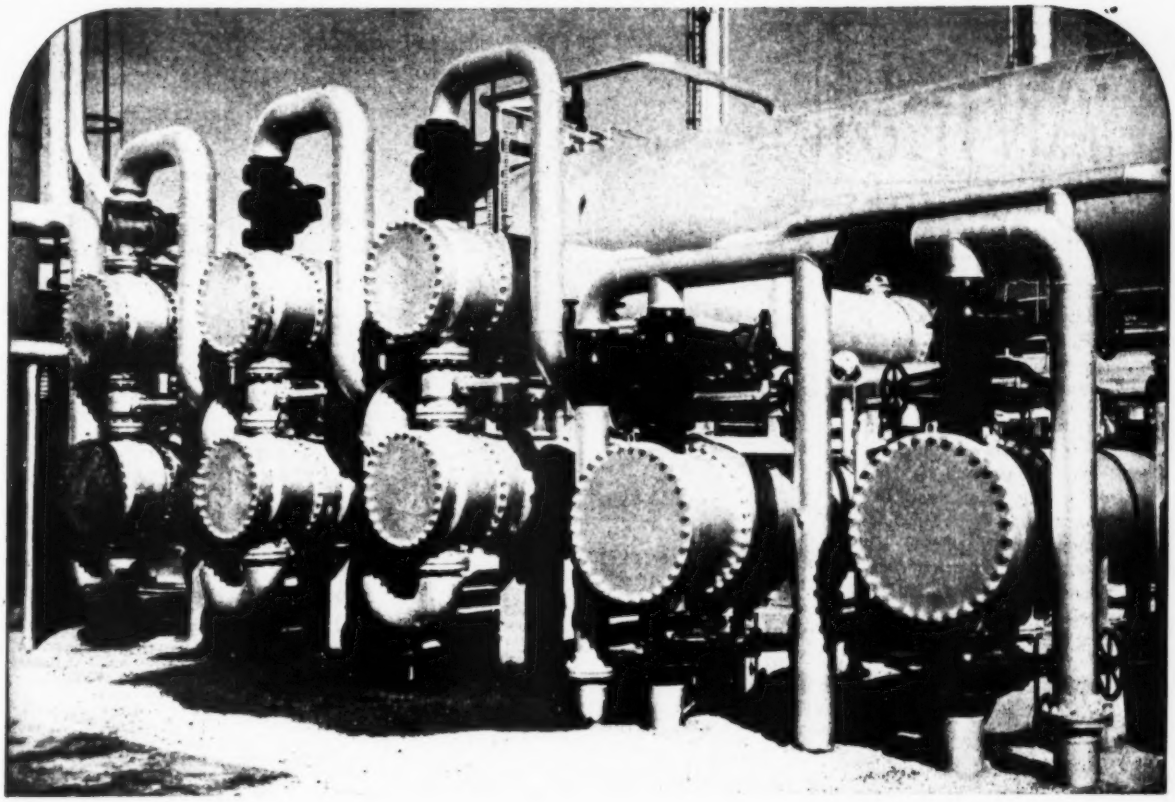
The plant will process 3000 barrels of naphtha daily. Provision has been made in the design for operation with high sulfur feedstocks, should crude market conditions dictate their use. The reformer is expected to be completed and in operation by June of this year.

Eastern States Adds New Alkylation Unit

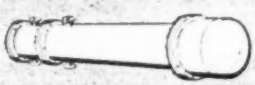
A new 3000-barrel-a-day aviation gasoline refining unit has gone on stream at Eastern States Petroleum Company's Houston refinery. Using a Kellogg process, Brown and Root, Inc., designed and built the unit, working in conjunction with Eastern States refinery maintenance forces.

Start-up of the new alkylation unit represents the completion of a phase of a $5 million expansion program which has been under way at the Houston refinery for the past three years. Other units constructed in the expansion include a platforming unit, benzene recovery plant and a solvent refining unit.

Construction to be started this year includes a UOP desulfurizing unit and a high-grade specialty naphtha plant. Cost of these two units was not given but will likely run well in excess of $2 mil-



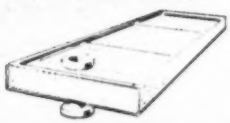
Make sure your Heat Exchangers are



HEAT EXCHANGERS

REBOILERS

CONDENSERS



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● Heat exchangers by EFCO specialists are carefully designed to meet *your* specific requirements. EFCO heat exchangers give you long, trouble-free operation plus the extra advantages of lasting tightness, optimum heat exchange, and minimum maintenance costs.

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PUMPING JOBS NOBODY ELSE WANTS!

You can buy lots of good pumps for ordinary pumping jobs, *but* NAGLE PUMPS are built to survive in those applications where ordinary pumps fail.

If you must pump highly abrasive mixtures, corrosive liquids, hot solutions or heavy slurries, then you will save by using NAGLE CENTRIFUGAL PUMPS. Engineered to your specific requirements—The right design, the right materials of construction. Horizontal and vertical shaft types in complete range of sizes. Send for Catalog 5206.

● Modified type "SW-O" vertical shaft pump built by Nagle for severe service in an atomic energy plant.

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PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

Who's Building . . .

lion. They are to be completed in 1955.

The naphtha plant will be part of the new Eastern States Chemical Company, organized two years ago.

Petco Division Adding Platforming Process Unit

The million dollar Platforming process unit now under construction at the Chicago refinery of the Clark Super 100 division of Petco Corporation will be operating within six months.

The unit is being built under a license granted by Universal Oil Products Company of Chicago, which holds the patents for this catalytic reforming process using a platinum catalyst. Procon, Inc., is constructing the unit. The Clark unit will be the first of its kind in the Chicago refining area and will be used in conjunction with Clark's $3 million Houdry catalytic cracker.

Sinclair to Add Reformer To East Chicago Refinery

A catalytic reformer employing a new platinum catalyst for producing higher octane gasolines will be built by Sinclair Refining Company at its East Chicago, Ind., refinery. The unit will have a capacity to increase the antiknock quality of 16,000 barrels of gasoline a day.

A construction contract for the reformer has been awarded to C. F. Braun

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No matter what your liquid hauling problem, we can help you. Each tank trailer manufactured is designed specifically for a particular job. Each is engineered for the product . . . for the truck . . . for individual state highway and ICC requirements . . . and each is designed to provide a maximum pay load.

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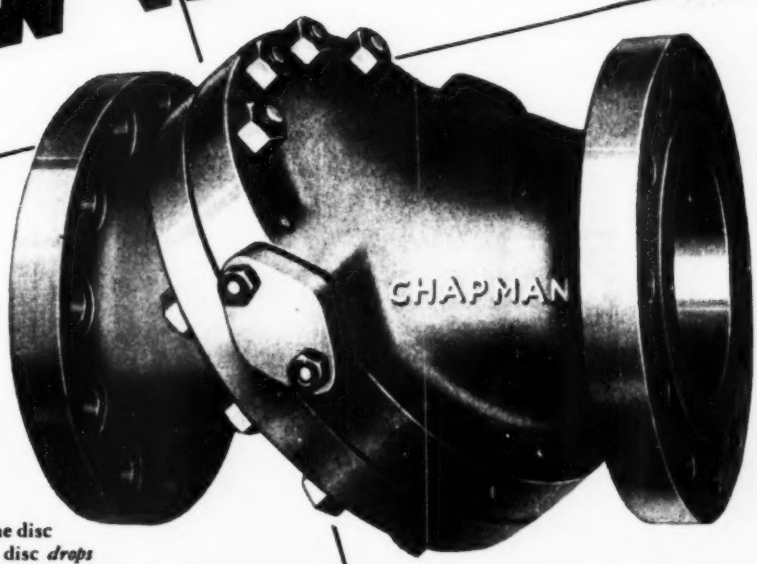
Only Chapman's *Tilting-Disc* Check Valves Give You...

NO SLAMMING
LOW HEAD LOSS
LOW WEAR



Here's the check valve that stays open with minimum flow resistance, closes fast without slamming, closes tight without sliding or scraping wear.

Cushioned Closing

Pressure against the upper part of the disc cushions it as it closes. Then the disc *drops tight* to its beveled seat after the valve has swung closed. Both actions are fast, but they are fluid-cushioned. Seating is quiet in all but unusual piping arrangements.

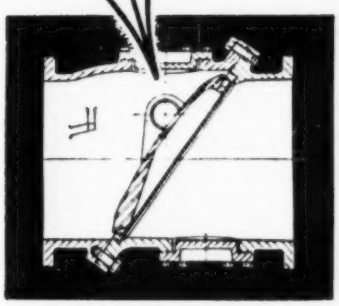
Low Flow Resistance

The streamline design of the valve body and disc eliminate turbulence and cut flow resistance. The fluid holds the disc tightly against its stops, without flutter. The body is larger around the disc, so the net valve area is at least as much as the pipe area.

Minimum Wearing Action

Because the disc *drops* tight, it doesn't slide against the seat. The wear on hinge pins is small because the disc doesn't flutter. Unusually husky construction in every detail means long life under the toughest conditions for Chapman's Tilting Disc Check Valve.

Full engineering and construction data are in Chapman's Catalog #30. Write for it now.



Here's Why CHAPMAN Tilting Disc Check Valves *Keep Quiet* All Their Lives

This specially designed "airfoil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

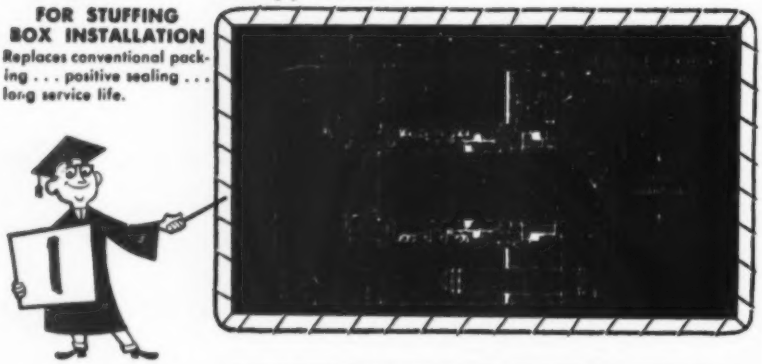
The CHAPMAN VALVE Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

For more data on advertised products, use Readers' Service Cards, last page.

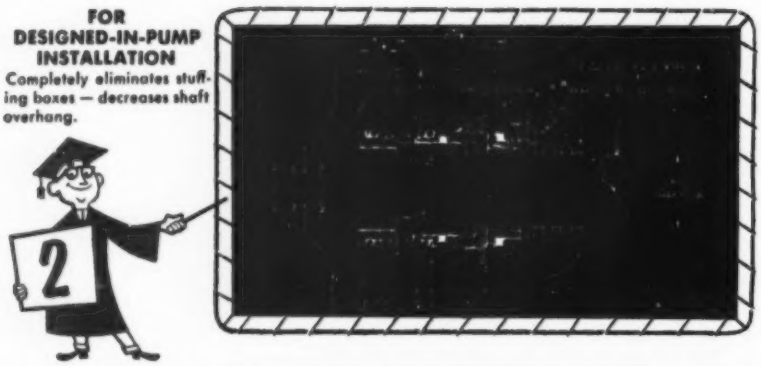
3 seals answer a thousand problems

Sealol-Flexibox — the high-efficiency mechanical seal with the unique spring drive — answers all types of shaft sealing problems.

FOR STUFFING BOX INSTALLATION
Replaces conventional packing . . . positive sealing . . . long service life.



FOR DESIGNED-IN-PUMP INSTALLATION
Completely eliminates stuffing boxes — decreases shaft overhang.



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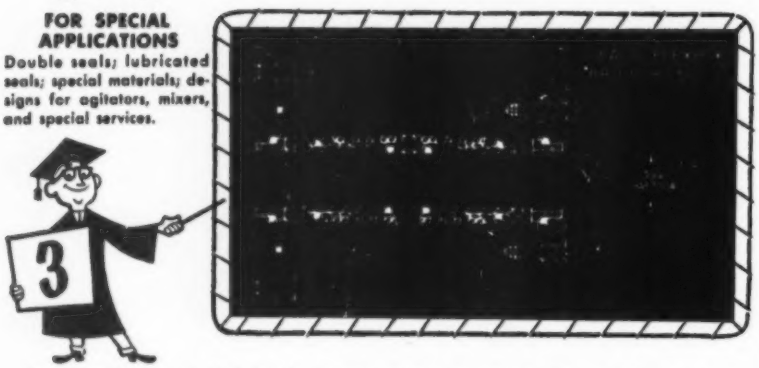
Double seals; lubricated seals; special materials; designs for agitators, mixers, and special services.



Send for Bulletin 9, full details on Sealol-Flexibox Seals. Also tell us about your shaft sealing problems . . . for engineering data and recommendations. Sealol Corporation, 13 Willard Avenue, Providence 5, Rhode Island.

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THE ▲ BALANCED PRESSURE SEAL

Who's Building . . .

& Company. Completion of the project is scheduled for early 1955. A new type boiler which converts what was formerly waste carbon monoxide gas from existing refinery facilities into heat will be built to supply steam to the reformer.

Texaco Starts Work on New Refinery Facilities

Construction has begun on a platforming unit, an alkylation unit and the expansion of other refining facilities at The Texas Company's refinery at Westville, N.J.

The platforming unit, which will use platinum as a catalyst to convert lower octane gasolines into higher quality gasoline, will have a rated capacity of 12,000 barrels a day. The contractor for construction of the platforming unit is Procon, Inc., Des Plaines, Ill.

The alkylation unit is designed to produce 1926 barrels of alkylate per day. Expansion plans call for the construction of an additional steam generator with a rated capacity of 275,000 pounds per hour, as well as additional water cooling facilities. Construction, now under way, is scheduled for completion by January 1, 1955.

United Chemical Plans $18 Million Urea Plant

Construction of an $18 million petrochemical plant is planned by a new firm, United Chemical Company, which was formed only recently by Grover Hartt, Dallas, Texas, oil man. To be built at Timpson, Texas, in Shelby County, the plant is slated to use natural gas as raw material to manufacture about 160 to 180 tons a day of urea and anhydrous ammonia fertilizers. Hartt, president of United Chemical, said about 100 tons are to be urea and the rest anhydrous ammonia.

Foster Wheeler Corporation will build the plant, which, initially, will process about 12 Mmcf of natural gas. Construction is scheduled to start in four or five months, Hartt said. The plant is to be completed in late 1955.

Socony Plans Expansion Of Cat Reforming Output

Expansion of its present catalytic reforming capacity to 93,000 barrels a day in the next three years is planned by Socony-Vacuum Oil Company. The expansion, which would almost double the present 47,000-barrel-a-day capacity, will increase the quality of gasoline. The planned new installations and necessary auxiliary equipment are expected to cost about $40 million.

SACOR Approaching End of Of Refinery Expansion

Part of the distillation section of the Cabo Ruivo refinery near Lisbon, Portugal, has been completed, and the enlarged plant is now putting through about 9000 barrels a day.

Operated by S. A. Concessionaria de Refinacao de Petroleos em Portugal

PETROLEUM CHEMICALS DIVISION
NEWS

April ★ One of a Series of Interest to the Petroleum Industry ★ 1954

100 BARRELS
of better public understanding

"By-the-barrel" is an unusual way to measure public relations. But we think it's appropriate in the case of the Du Pont *Magic Barrel* presentation.

So far 100 of these intriguing demonstrations have been put to work in the public relations programs of numerous oil companies and by the OHC.

The *Magic Barrel* was developed by the Du Pont Petroleum Chemicals Division to help the oil industry explain the tremendous and growing importance of petroleum to our national economy.

The 100 barrels now in use have been featured in more than 1000 public presentations and in 29 TV shows to an estimated total audience of around 5 million people. Its reception by the general public has been overwhelmingly favorable.

Du Pont Aviation Mix Now Available with Lower Blue Dye Concentration

Color specifications for military aviation gasoline have recently been revised. To make it easier for refiners to meet the new color standards, Du Pont Tetraethyl Lead Compound — Aviation Mix — is now being made with a lower concentration of blue dye.

In the new Aviation Mix, the dye concentration is sufficient so that there is no need for suppliers of military aviation gasoline to add additional Oil Blue A when a minimum of 4 cc. of TEL is used per gallon of gasoline. In this proportion, the new mix provides a safety margin of 4% above the minimum color specifications. And when 4.6 cc. of the mix per gallon of gasoline are added, the margin of safety is increased to 20%.

Until recently, color standards furnished to refiners were solutions of oil soluble dyes in iso-octane, and were subject to fading on exposure to sunlight. New color standards, with improved light stability, have been developed through the cooperative effort of the U. S. Air Force and the Du Pont Petroleum Chemicals Division.

These standards will assist refiners in meeting the new color specifications and may be obtained by following the procedures outlined in specification MIL-F-5572.

Du Pont Marketing Services Tailored to Fit YOUR OWN Promotions

Du Pont's Petroleum Chemicals Division has developed a wide range of marketing aids and services to meet the needs of the petroleum industry.

Here are some of the ideas which are helping many oil companies get extra mileage out of their present programs:

Enhancing the selling power of your own brand name is the over-all objective of the Du Pont marketing services program.

Suppose, for example, you have built up a reputation for the heavy-duty, long-lasting features of your motor oil. You have done such a good job of selling the motoring public on these qualities that they tend to minimize the need for frequent oil changes.

How can your dealers sell the need for oil change at regular intervals — without detracting from the quality features of your motor oil?

"... dirtied to death"

To help you overcome this problem, Du Pont developed a visual aid presentation which can be used at meetings to give dealers just the information they need. Its theme is: "Good oil seldom wears out . . . but it can become dirtied to death."

Your Greatest Asset

To help you capitalize the selling power of your name, the Du Pont Brand Name Program (suitable for larger oil companies) has provided another unique visual aid presentation. Specially designed to fit individual gasoline quality features and company marketing problems, it has proved useful for building dealer loyalty and supplying information that helps sell.

Demonstrate On-the-road Performance

Where could you find a more convincing tool for demonstrating how your

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED **Marketing Services**

products perform on the road than with a specially equipped and instrumented test car?

Several of the cars in the Du Pont Fuel Test Fleet can be made available to you for this purpose—on a special arrangement basis. These cars are an ideal aid in contacting large fleet customers. And when equipped with Du Pont supplied portable chassis dynamometers, the cars are useful for dealer meeting demonstrations.

Use of the Du Pont fleet of road test cars offers a unique and convincing approach to selling big fleet customers.

When the Customer Complains . . .

Your dealers need a ready, salesman-like answer whenever they get a customer complaint about knock, poor mileage, poor starting, etc.

Whatever your merchandising program, its success generally depends on your dealers. The majority of Du Pont marketing services are, therefore, designed to help you sharpen dealer sales techniques.

To help them handle such situations, Du Pont has prepared folders that answer the most common customer complaints. Illustrated with cartoons, these pocket-size folders are written in a direct style, easy to understand and to remember.

Get the Facts

A wealth of information on how your customers buy has been made available to you through Du Pont.

The Du Pont Consumer Gasoline Buying Habits Survey—based on thousands of interviews and service station observations throughout the country—documents the motoring public's habits and preferences in buying gasoline, motor oil and TBA products. Dealer services are covered, too. This information has proved a valuable aid in planning advertising and merchandising programs.

Broad Program

These are only a few of the many helpful marketing services furnished by Du Pont. The others include a movie lending library of films of significance to the petroleum industry, a quarterly nationwide survey of competitive octane ratings, a speaker service for dealer meetings and various oil industry public relations aids.

If you are not taking full advantage of these services, be sure to contact a Du Pont Petroleum Chemicals Division representative or one of the regional offices for details.

New District Manager Named

With expanding operations in the Du Pont Petroleum Chemicals Division's Eastern Region, a district office has been created in Pittsburgh.

Afton D. Puckett, who has been serving the Pittsburgh area as a sales-service representative for the past two years, has been named manager of the Pittsburgh district.

Previous to his first assignment in the Western Pennsylvania area, Mr. Puckett was coordinator of operations of the five district laboratories of the Du Pont Petroleum Chemicals Division. In this capacity, he also supervised technical work connected with the quarterly Motor Gasoline Survey.

Mr. Puckett joined the Du Pont Company in 1947. He was at that time put in charge of studies on antiknock properties of motor fuels at the Du Pont Combustion Engineering Laboratory. After receiving a chemical engineering degree from Oklahoma A & M College in 1936, he became an engineer for the Tide Water Associated Oil Company. From 1941 to 1946 he served as fuels chemist and petroleum engineer with the National Bureau of Standards. He then worked on diesel fuel problems at the U. S. Bureau of Mines Petroleum Experiment Station at Bartlesville, Oklahoma.

AFTON D. PUCKETT

Mr. Puckett is the author of several technical papers on combustion characteristics of motor and diesel fuels.

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A-7003

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(SACOR), the plant eventually will have a capacity of over 25,000 barrels a day.

Units scheduled for completion this year include a topping unit, which has a capacity of about 29,000 barrels a day, a 2500-barrel-a-day reformer and a 5000-barrel-a-day catalytic cracker.

Anglo-Iranian Expanding Continental Refineries

The Porto Marghera refinery near Venice, Italy, jointly owned by Anglo-Iranian Oil Company and Azienda Generale Italiana Petroli, is now producing lubricating oils. Completion of acid and clay treatment units will enable the refinery to produce approximately 107,000 barrels of lube oil annually.

Other important new units being commissioned this year at Continental refineries operated by Anglo-Iranian and associates:

A nearly completed new distillation unit at the BP Hamburg refinery which will raise its capacity from 14,000 barrels a day to nearly 25,000 barrels a day. Also a 5000-barrel-a-day platformer for the production of high grade motor fuel components at Hamburg, expected to be in operation by September.

A new furfural treating plant at the Schindler, Germany, refinery, which will increase the output of lubricating oils there from 151,900 to 250,000 barrels annually when completed in June.

A platformer at the Lavera refinery in Southern France, owned by Anglo-Iranian's French associate, Societe Generale des Huiles de Petrole. Scheduled to be commissioned in November.

A catalytic cracking plant and a catalytic polymerization unit at the Antwerp refinery in Belgium, jointly owned by the Petrofina Company. Both units are to be commissioned in the first quarter of 1955. At the same time modifications are being made to existing units which will increase the Antwerp refinery's capacity from 36,000 to 54,000 barrels a day.

CHEMICALS WANTED

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

p-Quinquephenyl
Decaborane
Trimethylamminoborine
3-Methylthiophene
2-Methyl-2-hexanol
Cyclohexanone peroxide
Tetramethyl-p-benzoquinone
N-Methylpiperidine
o-Nitrophenylpropiolic acid
Dimethyl zinc
2,5-Dimethylfuran
Chromium hexacarbonyl
3,3,3-Trichloropropene
Dimethyl sulfene
1-Chloro-2-naphthol
2,2-Dichloroethanol

Okadee
"THE PERFECT SEAL"
WRING FIT

No magic... No magnetism... lapped wring fit of every Okadee Valve disc and seat must pass this test of a perfect sealing surface. (unretouched photo)

... Here's What it Means to You in Terms of Valve Service

Flat mating surfaces within .000005", or less, of every set of Okadee valve discs and seats mean absolute shut-off of any material from ammonia gas to asphalt.

How long does this seal last in service? We honestly don't know. Tests under working conditions with propane were stopped after 269,000 operating cycles when no wear or seal failure could be detected. And Okadee valves do not have to be babied in service on corrosive or abrasive materials . . . Thousands of boilers have had Okadee blow-down valves in continuous, trouble-free service for fifteen years or more. If Okadee size-pressure-temperature ranges include your valve applications, Okadee installation will end your problems of valve performance once and for all.

Okadee valves are available in single-disc (one direction) and double-disc (two directions) types; screwed or flanged; ½" to 6" in standard A.S.A. dimensions; steel or semi-steel bodies (other materials to order); stainless steel or stellite seat facings; levers, rack-and-lever, worm-gear, hydraulic, pneumatic, automatic on-off control.

Write for Bulletin 332-G today!

OKa Okadee COMPANY
332 South Michigan Avenue • Chicago 4, Illinois

For more data on advertised products, use Readers' Service Cards, last page.

that finishing touch

. . . like dotting the "i"

NATURAL GASOLINE

gives that finishing touch—
"RETAINED VOLATILITY"

to YOUR Motor Fuel

Working up unfinished gasoline stocks to meet the vagaries of Motor Fuel demand in the Spring is no problem when you rely on WARREN for the Quantity and Quality of Natural Gasoline . . . when and where you want it.

WARREN

PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN
TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

Where's the Fire?

Fire extinguishment in oil processing, storage and transport facilities

Part II

H. B. Williams, Director,
Safety and Fire Protection,
Pan American Refining Corporation,
Texas City, Texas

Sphere, Top Fire

1. **Caution:** Do not extinguish flames except by fuel elimination as described in the following paragraphs.

2. Apply cooling water streams to the top valve assembly and to the top of the tank so the runoff will cover the shell. Cooling streams should be continued after flame extinguishment until all danger of re-ignition from hot steel has been eliminated. Apply cooling streams in an adequate manner to threatened tanks.

3. Open the bypass around the back pressure regulator carefully to vent excessive pressure to the plant torch or vapor recovery system.

4. Stop movement of product to the tank.

5. Regulate firewall drain valves as required to remove water from the tank basin at a rate that will maintain a water seal over the sewer opening. This is to prevent propagation of flame through sewer lines.

6. Pump out the tank contents to unaffected storage at a rate which will not pull a vacuum within the tank.

7. When product pump-out has reached the limit as determined by available storage space, pump operation, etc., refill the tank with water to float all remaining flammable material to the point of leakage. Exercise all precaution to avoid forcing flammable liquid under pressure through the leak. If sufficient space exists above the leak, and if the opening is not excessive, a rapid rate of water fill can be employed to float the flammable liquid above the leak. Should this procedure be followed, the flames will be extinguished when water covers the leak. Pumping should continue, however, until water appears in the torch liquid drum indicating that the flammable material has been eliminated.

Sphere, Bottom Fire

1. **Caution:** Do not extinguish flames except by fuel elimination as described in the following paragraphs.

2. Apply cooling water streams to the top of the tank so runoff will cover the shell; to the supporting structure and to the bottom piping assembly. Cooling streams should be maintained after flame extinguishment until all danger of re-ignition from hot steel has been eliminated. Apply cooling streams in an adequate manner to threatened tanks.

3. Open the bypass around the back pressure regulator carefully to vent excessive pressure to the plant torch or vapor recovery system.

4. Stop movement of product to or from the tank.

5. Regulate firewall drain valves as required to remove water from the tank basin at a rate that will maintain a water seal over the sewer opening. This is to prevent propagation of flame through sewer lines.

6. Pump water to the tank to float the flammable material above the leak. This will extinguish the flames if the water pumping rate exceeds the rate of leakage. Care must be exercised to avoid flooding the torch with liquid hydrocarbon. Proceed with the gas freeing of the tank according to normal operational plans.

7. Should a shell failure below the liquid level of the tank result in leakage which exceeds the capacity of water pumping facilities, maximum water pumping capacity should be utilized in order to minimize the quantity of flammable liquid flowing through the leak under tank pressure. In such an event several solid streams of water should be brought to bear on the shell surrounding the leak to form a curtain of water spray which should be maintained until all flammable material has been consumed, and the tank has become gas free by natural ventilation or by the addition of steam to the vapor space of the tank.

End of Part II. Part III will appear in an early issue.

TAFT-HARTLEY

Continued from Page 106

the beginning of the end of collective bargaining and free enterprise. All industry should oppose this amendment.

Q. *What are your views on the "states rights" amendment?*

A. The courts have held that the Taft-Hartley Act has "taken over" from the states the right to regulate labor relations. I think labor relations is a local, not a national, problem. The state laws should have an opportunity to work in this field. To take this position we, as employers, have to take the bad with the good because in some states the state law is better and in some states worse than Taft-Hartley. In any event, I think we should stand on the principle that a local matter like bargaining should be controlled, to the extent it needs control, by local laws. In addition to the principle involved, there are the practical aspects of this problem. If the state and local authorities can claim that even the police work in labor matters is a federal problem they won't be encouraged much to do their unpleasant duty in such cases as picket line disorder and unlawful picketing. I

Sure Cure

FOR PROFIT-DRAINING PRODUCTION SHUT-DOWNS

NEW 800 HANCOCK STEEL GATE VALVE TYPE 950

Bolted Bonnet

Outside Screw and Yoke

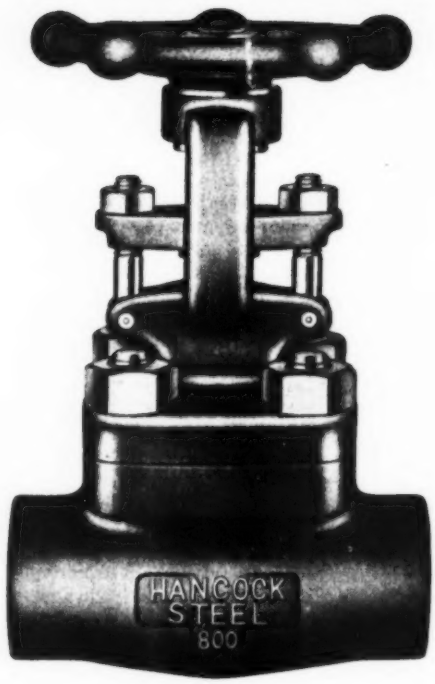
Sizes 1 4" through 1"

This new 800# Hancock Bolted Bonnet Steel Gate Valve is typical of the outstanding quality which has always made Hancock Valves the best buy in terms of long, efficient, trouble-free performance. It more than meets the exacting requirements of process and power piping systems in refineries, petrochemical, power and industrial plants. Built into this new Type 950 are design and operational features proved in the toughest services. Here are construction elements you get in this new Hancock 800# Bolted Bonnet Steel Gate Valve:

1. **Spiral wound stainless steel gasket.**
2. **"500 Brinell" stainless steel wedge.**
3. **11-13% chrome stainless steel seats.**
4. **Stainless steel swing bolts and nuts.**
5. **Highly accurate guiding to prevent wedge dragging on seating surfaces and consequent leakage.**
6. **Positive back seating.**
7. **Corrosion-inhibiting packing that assures complete freedom from stem pitting.**
8. **Repacking ease.**
9. **Safe, comfortable handwheel built to operator's specifications.**
10. **Corrosion-resistant exterior finish.**

Be sure of complete dependability and long-life economy. Reduce maintenance and inventory costs. Install Hancock 800# *Bolted Bonnet* Steel Gate Valves. Remember, they cost no more than ordinary valves, yet do a job and stay on the job.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR knows the *economy of quality* that's built into all Hancock Valves. You can depend on him for practical counsel as well as prompt delivery from local stocks.



Service Ratings

Screwed and Socket Weld Ends: For all pressures up to 800 psi at 775°F. — O.W.G. 2000 psi, 100°F.

Flanged Ends: For all pressures up to 800 psi at 775°F. — O.W.G. 1440 psi, 100°F.

Alternate Trims include:

Cobalt-Chromium-Tungsten Alloy, Hard Facing.
18-8% Stainless or 20% Nickel, 8% Chrome.
Monel.
Hastelloy.

When Hancocks go in, valve costs go down

1077 HANCOCK U.S.A.

MAXWELL

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

think we should encourage the administration to go as far as possible in the direction of getting control of labor relations, where needed, back to the local level where it belongs.

Q. *Do you think the strike ballot provision would do any good?*

A. I think I am about the last person in the U. S. who favors this amendment. I still do, though. I believe some provision is necessary to assure individual employes the opportunity to vote on the strike issue without fear of reprisal in a secret ballot. I think employes have a right to be sure that their ballots receive a fair count. I am also convinced that most strike votes taken *before* the strike starts are taken for the avowed purpose of strengthening the union's hand in bargaining. The employe who votes "yes" not only feels that he wont have to strike, but moreover has not tasted the bitterness of being without a pay check—at least not lately. So I believe there is a distinct advantage in taking the vote *after* rather than *before* the strike starts. Some people say that is locking the barn after the horse is stolen. I agree that locking the barn won't do much good, but who can object to chasing after the horse?

The author requests that it be made clear that the views expressed herein are his own, and do not necessarily reflect the opinion of his company.

Q. *If anyone has any strong feelings about this Taft-Hartley business, what should he do?*

A. See his Senators and Congressman; write to his Senators and Congressman; telephone his Senators and Congressman; telegraph his Senators and Congressman. Do this even though you *know* your Senators and Congressman are "thinking right" on this program; do it even if you *know* that they are completely opposed to what you will advocate.

Q. *Do Senators and Congressmen pay any attention to letters, telegrams, telephone calls, and visits?*

A. They certainly do! A lawmaker's "mail" tells him what his people are thinking. He does not want to oppose those views. He loses votes if he does. A visit from a constituent either at home at recess time, or in Washington is welcomed by the lawmaker as an opportunity to hear the details of what his people think.

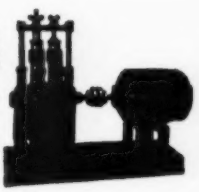
Whatever YOUR Need in Chemical Feeders

MULTI-FEED CHEMICAL FEEDERS

Manzel flexibility permits *accurate* feeding of *many* different chemicals simultaneously. Chemicals can be pumped *into* other liquids or test samples drawn from production at regular intervals. The illustration shows a Manzel with 7 feeds, each of which can be individually set to draw an exact amount of chemical from its own tank

LARGE OR SMALL CAPACITIES

Manzels Chemical Feeders pump from a fraction of a drop to 60 gph per feed . . . with *unsurpassed accuracy and dependability* You eliminate troubles due to guesswork, inaccuracy, or forgetfulness Any number of feeds, any type of drive Easily synchronized with any process



● When you have a problem of feeding one liquid into another . . . no matter how light, or heavy, or corrosive . . . you can rely on Manzel's long experience in *precision* proportional pumping.

Manzel Chemical Feeders can be individually engineered for most applications . . . and they are priced much lower than you might expect. Write for details today.

Ask Manzel

Division of Frontier Industries, Inc.
285 Babcock Street
Buffalo 10, N. Y.

SPECIALIZING IN HIGH PRESSURE METERING PUMPS SINCE 1898

For more data on advertised products, use Readers' Service Cards, last page.

HEAT EXCHANGERS

for CORROSIVE and NONCORROSIVE LIQUIDS and GASES

Industrial tailored units

Whether for laboratory or pilot-plant requirements or large-quantity processing, it will pay you to look into the INDUSTRIAL tailored units for heating or cooling liquids or gases. Rather than adaptations of standard units, INDUSTRIAL heat exchangers are engineered and built to individual performance specifications. Depending on size and other operating conditions, the INDUSTRIAL heat exchanger may be a large single- or multiple-pass tube-bundle type or a series, parallel, or series-parallel combination of individual single- or multiple-tube units. In any type unit, thermal shock and the requirements of the corrosive or noncorrosive fluid on the tube or shell side determines the materials of construction. Thus, each INDUSTRIAL tailored heat exchanger embodies the ultimate in operating performance and efficiency at lower initial and maintenance costs.

Get INDUSTRIAL'S recommendations for your next heat transfer equipment.

This Bulletin describes the INDUSTRIAL service on heat transfer equipment. Ask for Bulletin 600-2.

5009

INDUSTRIAL

FILTER & PUMP MFG. CO.

5924 Ogden Avenue · Chicago 50, Illinois

PRESSURE FILTERS
DEMINERALIZERS
RUBBER LININGS
HEAT EXCHANGERS
CENTRIFUGAL PUMPS

As Management Sees It . . .

TOO OLD

Continued from Page 107

average lifetime of the American people reached a new high of 68 plus—a gain of 21 years since 1900. Whether, as Professor Pitkin wrote in "Life Begins at Forty," babies born now will live past the century mark hale, hardy and zestful remains to be seen. But not by us. We can easily see, however, that our population is older. Workers can stay on the job longer and can live longer afterwards.

—Not This

- Myths About Older Workers
  - Older workers are crabby
  - Older workers can't take supervision
  - Older workers can't learn
  - Older workers are inflexible
  - Older workers are not ambitious

(These are unestablished stereotypes disclosed by Dr. Irving Lorge, Columbia University psychologist, based on interviews with workers and employers).

—But This!

- Older Workers Perform Well—But Differently
  - They stress accuracy over speed
  - Differences in individual performance increases with age
  - Industrial skills can be maintained at older ages than when *learned* under present training methods
  - Older people are more content and efficient in small work groups

(Based on laboratory studies reported by New York State Joint Legislative Committee on Problems of Aging).

The Issue We Face—This lengthening march of oldsters raises a cloud of gloom or outlines a new horizon of hope and possibility. When we consider that by 1980, $28.8 billion for pensions of $100 a month might be paid to an estimated 24 million persons over 65 for not working, budget balancing becomes a national nightmare. Support of nonproductive people—our children, the sick and disabled and the aged, if not employed—must come out of national production. In the long run, there must be direct aid or government benefits supported by taxes. The dollar drain can be somewhat reduced by keeping older workers on the job and by preparing them for reasonably independent living afterwards. A potential increase of at least 600,000 in the labor force is possible today by utilizing older workers capable of working under proper conditions. Industry must find a way

Still 'tops'
In Catalyst Recovery

Multi-stage Buell Collector for catalyst recovery engineered to eliminate the need for supplementary collection equipment.

For both fluid and thermofor catalytic cracking Buell high-efficiency cyclones continue to function successfully in separating catalyst materials from the vapor stream. All major oil refineries are included in Buell's customer list. For complete information on all types of dust collection and recovery write: Buell Engineering Company, Dept. 21-D, 70 Pine Street, New York 5, N. Y.

buell®

MECHANICAL ELECTRICAL

20 Years of Engineered Efficiency in
CATALYST RECOVERY

For more data on advertised products, use Readers' Service Cards, last page.

Why I keep 2 spare gauge glasses

For top boiler safety, the experts tell me never to put the same glass into a gauge after I've had it apart.

That's why I always keep *one* spare around. The other one? Well, I like to feel that, if someone should accidentally break a gauge, I've got another one all ready to go into place, without losing any valuable time.

In football, they call it "depth." In boiler maintenance, they call it smart planning. And for the few cents it costs to buy two spares, I get rid of a bothersome replacement problem.

• • •

Why don't *you* give yourself that confidence? Call your industrial distributor and order *two* spares for every boiler in your plant. Of course, you'll want PYREX brand gauge glasses —safest on the market, because of strong, heat-resistant construction. They're easier to read, too, because their chemical stability resists corrosion by steam, keeps glass fog-free longer.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	*Recommended Product*
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Viewing inside furnaces, reactors pressure vessels, etc.	PYREX brand sight glasses
Lubrication Inspection	PYREX brand lubricator glasses
Visible discharge devices	PYREX brand oil cup glasses

PYREX T.M. REG. U.S. PAT. OFF.

CORNING GLASS WORKS
Corning, New York

Corning means research in Glass

As Management Sees It . . .

to adjust jobs to meet their abilities.

Problems or Potentials?—The main questions raised by an aging labor force are: opportunities for effective contribution on the job and preparation for a useful after-work lifetime.

Judged by its interest in employe welfare, petroleum refining is well ahead of most American industry in accomplishment and potentiality. According to an impartial government study, oil industry "benefits in the event of death, sickness and accident, and old age . . . are of special significance because they are illustrative of the rather comprehensive employe-benefit programs developed over the years by firms that have given a great deal of attention to the problem involved." And this is not just a recent or passing interest. Standard Oil Company (New Jersey) has a program 50 years old.

Practically all plans are sponsored and run by the companies. However, almost all are jointly supported, at least in part, by employer and employe contributions. This pattern contrasts sharply with the usual industrial plan, conceived and pressured into being under wartime stabilization and collective bargaining. Without comparing individual benefits and total programs, it is clear that oil refining has demonstrated a longer, better established and less opportunistic concern for these fringe conditions. On this basis, as well as its respected employment standards, oil can also pioneer in the subtler yet more meaningful programs of utilizing older workers

Suggested Pattern For Your Program

1. Recruit older workers for suitable jobs
   Determine where they can be used by analyzing jobs now filled by older workers; studying job requirements; company production, medical, turnover, absence records.
2. Maintain older worker efficiency
   Adjust hours, work schedules, physical conditions (light, heat, noise). Provide proper facilities and tools. Give health examinations and advice. Offer personal counseling on aging problems: health, money matters, psychological adjustments, using individual and group techniques.
3. Reassign jobs
   Determine objectively when production declines and examine interest and capabilities for other work. Transfer instead of demote or downgrade by careful preparation and appeal to worker understanding. Use teamwork and group approach; don't single out individual workers.
4. Prepare for Retirement
   Basic educational program. Follow up special areas of interest and individual questions. Encourage further study by those desiring help or are stimulated by group discussion. Use outside specialists to cover particular subjects and lend authority to the guidance.
5. Retirement Policy
   Compare mandatory and elective age practices. Consider a "selective" process based on age, ability, objective tests, interest and financial status. Consider employe committee devices as a recommending group for voluntary retirement.
6. Post-Retirement
   Integrate the ex-employe into the company family by newsletter, service clubs, visiting programs, company facilities and retiring preference.

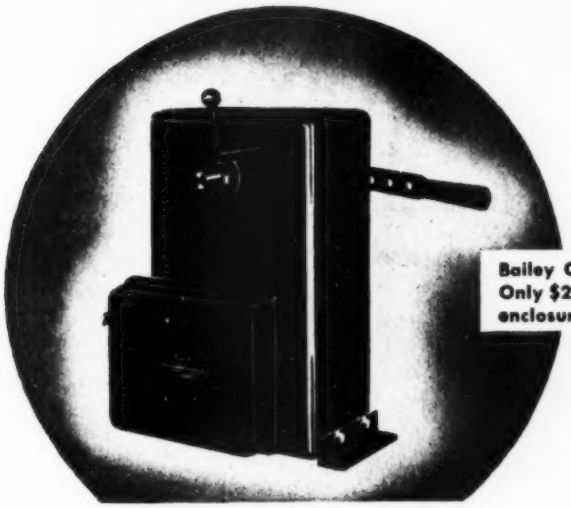
(Based on "Effective Use of the Older Worker" by Elizabeth Breckinridge, Chapter 13).

Population of the United States, by Age and Sex: 1900 to 1950
(Percentages based on rounded figures. Figures for 1900 to 1930 adjusted to include persons of unknown age)

AGE	NUMBER (in millions)						Percent Increase 1900–1950	PERCENT DISTRIBUTION					
	1900	1910	1920	1930	1940	1950		1900	1910	1920	1930	1940	1950
Total, All Ages	76.0	92.0	105.7	122.8	131.7	150.7	98	100.0	100.0	100.0	100.0	100.0	100.0
Under 10 Years	18.1	20.4	23.0	24.1	21.3	29.4	62	23.8	22.2	21.8	19.6	16.2	19.5
10 to 19 Years	15.7	18.2	20.1	23.6	24.1	21.7	38	20.7	19.8	19.0	19.2	18.3	14.4
20 to 34 Years	19.5	24.2	26.5	29.9	32.9	35.2	81	25.6	26.4	25.1	24.3	25.0	23.4
35 to 44 Years	9.2	11.7	14.2	17.2	18.3	21.5	134	12.1	12.7	13.4	14.0	13.9	14.3
45 to 54 Years	6.4	8.4	10.5	13.0	15.5	17.3	170	8.4	9.1	9.9	10.6	11.8	11.5
55 to 64 Years	4.0	5.1	6.5	8.4	10.8	13.3	232	5.3	5.5	6.2	6.9	8.0	8.8
65 and Over	3.1	4.0	4.9	6.6	9.0	12.3	297	4.1	4.3	4.6	5.4	6.8	8.1

Source: Adapted by the Bureau of Labor Statistics from U. S. Bureau of the Census. *U. S. Census of Population: 1950*, Vol. II *Characteristics of the Population*, Part I, United States Summary.

For more data on advertised products, use Readers' Service Cards, last page.



Bailey Control Drive, Type AC44P Model 200. Only $210.00 F.O.B. Cleveland, complete with enclosure, positioning relay and hand operator.

Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

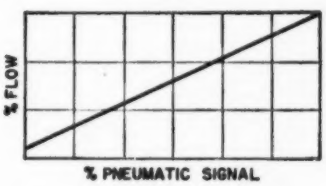
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

AVAILABLE FROM STOCK in 3 standard sizes

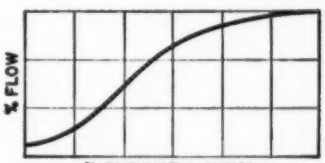
Type	Piston Dia. Inches	Piston Stroke Inches	Torque ft-lb	Max. Travel Degrees	Approx. Dimensions Inches
AC816	8	16	1500	90	13 x 27 x 51
AC68	6	8	400	90	13 x 19 x 34
AC44	4	4	75	75	10 x 11 x 19

P-28

The New Bailey Control Drive gives you THIS—



instead of THIS



BAILEY METER COMPANY

1043 IVANHOE ROAD

CLEVELAND 10, OHIO

Complete Controls for Process Plants

BAILEY METERS

Controls for

TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO

For more data on advertised products, use Readers' Service Cards, last page.

What are best painting recommendations—*today*—for the special conditions encountered in petroleum service on tanks . . . towers . . . piping . . . equipment?

One sure way of getting recommendations—and materials—reflecting latest advances in paint technology is to consult Sherwin-Williams. You'll find competent petroleum industry experience available from your Sherwin-Williams Petroleum Sales Representative, and useful specifications covering petroleum applications in the new Sherwin-Williams Brochure B-770. Ask for your copy—call, wire or write. The Sherwin-Williams Co., Petroleum Division, Cleveland 1, Ohio.

As Management Sees It . . .

and schooling them for a satisfying old age.

In the 73 plans studied covering 70 percent of the refining industry, nine different benefits were found:

life insurance or death benefits
accidental death and dismemberment
sick leave
sickness and accident
hospitalization
surgical care
other medical care
retirement
permanent and total disability

Life insurance, temporary disability and retirement were most common.

The industry ranks high economically. Refining is a continuous process, is most efficient when running day and night at capacity. Employment is stable, turnover is low. The industry is largely run by experienced men; in 1947, they averaged over 36, two years older than the national industrial figure. Women make up less than 10 percent of the work force compared with 33 percent in all industries. Wages are relatively high, about $1000 a year above the average for industry generally. Safety conditions are good, too. Injuries are about half the number for manufacturing, but admittedly more serious.

Petroleum refining has an impressive head start—a solid industry, a tradition of employe welfare, and future prospects unlimited in a nation built on, and built for, power. The conditions and opportunities are ripe for improving further and where it counts most: with the experienced, loyal worker who is prepared and anxious to serve as long as he can, given the chance, and who will reflect credit on the company once he leaves.

Fit the Plan to the Plant The keystone of any program for keeping workers steadily, or at least effectively, on the job and training them for life after the job is to gear the plan into the regular company environment. New ideas, modern methods and latest findings should be considered, but *applied* and *adapted* to company traditions and policies. That's why the facts and figures on the industry's experience and attitude toward employe benefits has meaning, why the character of the labor force was studied and its record of employment and wages. Without this background, there would be no point at which to start and, worse, no point of return.

Since the industry has fair wages, a good network of welfare plans and a steady work group with family interests, we can reasonably consider personnel

Right down to the last Nut and Bolt

ARTHUR G. MCKEE & COMPANY are organized to take complete responsibility for ***all details*** of your project from the preliminary planning stage through complete construction—literally down to the last nut and bolt.

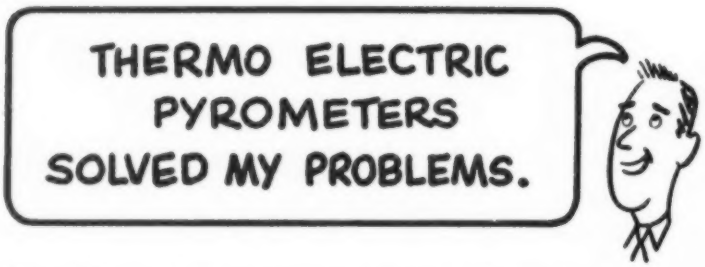
The advantages of this undivided responsibility are manifold. You are relieved of the necessity of hiring technical help and field crews, of negotiating with numerous sub-contractors and suppliers, of co-ordinating activities and arrival of materials, of time-keeping, supervision, inspection and countless other details.

McKee performs all these functions under a ***single contract*** and with a thoroughness and efficiency born of long, specialized experience.

Arthur G. McKee & Company • Engineers and Contractors

Headquarters: McKee Building • 2300 Chester Avenue • Cleveland 1, Ohio
Offices: New York • Tulsa, Oklahoma • Union, N. J. • Washington, D. C.
British Representatives of Metals Division: Head, Wrightson & Co., Limited
Canada: Arthur G. McKee & Company of Canada, Ltd., 350 Bay St., Toronto

McKee Engineering Services



Thermo Electric makes many products that help solve problems in the field of temperature measurement and control. T-E controllers and indicating-recorders are good examples. They are both made in two types: potentiometer pyrometer and resistance thermometer. They are accurate (±¼ of 1% of the range), rugged, simple in design, easy to maintain. Ranges from −100°—+600°F up to 0—3000°F.

THERMO ELECTRONIC INDICATING-RECORDER

Only three moving parts in the recording system—pen arm is driven from a cam, which permits linear charts to be used for all temperature measurements—full scale pen travel only 4 seconds. Easily adapted to measure humidity, solution conductivity, speed, pH, direct current, DC voltage, or other variables.

THERMO ELECTRONIC CONTROLLER

Two-position control action is continuous and instantaneous — potentiometer pyrometer type is sensitive to changes of as little as ±1.5°F, or less; resistance thermometer type is sensitive to changes of as little as ±0.1°F.

Write for details:

controller, potentiometer pyrometer type, bulletin 50—X
controller, resistance thermometer type, bulletin 55—X
indicating-recorder, both types, bulletin 60—X

Pyrometers • Thermocouples • Protection Tubes • Quick-Coupling Connectors
Thermocouple and Extension Wires • Resistance Bulbs • Connector Panels

Thermo Electric Co., Inc.

SADDLE RIVER TOWNSHIP, ROCHELLE PARK POST OFFICE, NEW JERSEY
IN CANADA—THERMO ELECTRIC (Canada) Ltd., BRAMPTON, ONTARIO

As Management Sees It . . .

utilization and worker retirement. Otherwise, on the simple formula of first-things-first, the industry would do well (and individual plants should study their standing) to institute cash and service benefits, better working conditions and health and safety programs.

Work versus Retirement—The issue that rises to the top in this crucible of problems on the older worker is fixed versus flexible retirement. Traditionally, where pension systems existed a compulsory quitting age was set. Why? It was argued that such a rule forced workers to prepare; that it insured relatively steady promotion for younger men; that it permitted more accurate labor cost accounting; that it ruled out favoritism and finally, that this certainly was desired and deserved.

Many of these arguments, in particular situations, are valid, but are probably invalid when applied unconditionally. They wrongly assume that chronological age is a proper measure of ability, that people do in fact plan against a certain eventuality, that we have a static rather than dynamic and expanding economy and, worst error of all, that people prefer not to work.

Many firms are re-examining mandatory retirement policies in light of scientifically proven facts that older men are capable of learning new techniques and are definitely more reliable and punctual. Their experience and training often more than outmatch physical strength and endurance. Also, economic studies have established that age makes no difference in desire to work, to keep active and to contribute when, if well, men over 60 and 65 generally outproduce their juniors. And many who have health handicaps can continue effectively in lighter work, at shorter hours, under adjusted work conditions and, underscore this,

Features of 73 Employe-Benefit Plans in Petroleum Refining Industry

Type of Benefit	Plans	Employes Covered[1]
Total	100.0%	95.2%
Life Insurance	91.8	80.9
Accidental Death and Dismemberment	38.3	22.0
Temporary Disability	83.5	77.0
Formal Sick Leave[2]	52.0	66.4
Sickness and Accident	42.5	22.0
Hospitalization	83.5	57.0
Surgical	74.0	54.7
Other Medical Care	20.5	18.2
Retirement	74.0	78.4
Permanent Disability	8.2	25.4

[1] 139,000 employes of 64 firms out of estimated 200,000 total employment 1949-50.
[2] Formal sick leave and sickness and accident benefits supplement each other in eight plans.

Source: Zisman, Joseph and Carlson, Julia. *Seventy-Three Employe-Benefit Plans in the Petroleum Refining Industry*. Bureau Memorandum No. 70, Federal Security Agency, April, 1951 (p. 5).

REPUBLIC ALLOY STEEL STUDS
help lick stud failures caused by

Tough, heavy-duty Republic Alloy Steel Studs assure maximum tensile strength to stand up against and help lick the three common causes of stud failure—high pressures, high temperatures and corrosion.

Republic-made alloy steels provide toughness and strength under temperature extremes—resist corrosion. Clean accurate threads provide maximum holding power, resistance to wear, easy tightening, trouble-free back-off for maintenance.

Specify Republic Alloy Steel Studs on your next pressure vessel order. Carry them in stock as replacements on present equipment.

REPUBLIC STEEL CORPORATION
Bolt and Nut Division • Cleveland 13, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, New York

REPUBLIC BOLTS AND NUTS

REPUBLIC STEEL

Other Republic Products include Carbon, Alloy and Stainless Steels — Bolts and Nuts, Steel and Plastic Pipe, Heat Exchanger Tubes

For more data on advertised products, use Readers' Service Cards, last page.

Controlled Pressure

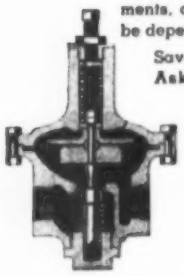
for efficient operation

Clark Pressure Reducing and Regulating Valves

are precision-made for positive pressure control on air, gas or steam lines.

Where different types of equipment, with varying pressure requirements, are operated from a common line, Clark Regulating Valves can be depended on to deliver automatically the "just right" pressure to each.

Save on fuel, maintenance and protect expensive equipment. Ask your Clark representative to specify the right Clark valves for your needs . . . or write us direct.

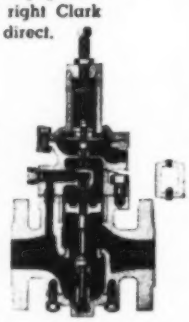


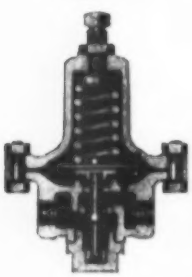
TYPE KRV

Pressure Reducing Valve. Diaphragm Operated-Single Seated Valve. Sizes ½" to 1½" for initial pressures up to 250 P.S.I. Reduced pressures to 85 P.S.I.

TYPE CRV

Pressure Reducing Valve. Integral pilot controlled, piston operated. For pressure control from "dead end" to full capacity. Sizes ½" to 6".





TYPE ORV

Pressure Reducing Valve. ⅜" and ½" Single Seated, Spring Loaded, Diaphragm Actuated. For initial pressures to 250 P.S.I. Reduced pressures to 200 P.S.I.

QUICK-CLEANING STRAINERS

Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" I.P.S. For pressures to 250 P.S.I.

HOME OF DUO-STEP [illegible]RAGE

Clark

MANUFACTURING COMPANY

1830 EAST 38th STREET

CLEVELAND 14, OHIO

Distributors and Representatives in all major cities

As Management Sees It . . .

with sympathetic management.

Learn Before Leaving—Assuming management through its democratic processes has worked out means for profitable use of senior employes through work scheduling, retraining, transfer and adjustment for handicap with fair wage scales, there still remains the job of preparing for the eventual leaving. Whether retirement is must or maybe at a certain age, there will be a severance. According to the current life tables, a man at 50 has 23 years ahead of him, at 60 about 16 years and at 65, about 13. At 70, he can on the average look forward to another decade. For women, these expectancies are even greater.

A study of plans designed to anticipate retirement properly undertaken by the Executive Secretary of the Illinois Committee on Aging (1952), discovered that interested companies want to know: When to begin such a program, how, what should it cover, should it be separate, what responsibility should the personnel, medical or other department take, and, how can acceptance be obtained.

Obviously, there are no set rules, but the familiar principle of erecting new structures on well-established foundations still holds. Preferably, the concept of planning should begin when the employe enters—he should at least be advised that the plant medical, safety, employe benefit and counseling programs have been united so that he may rise within the company and, upon release, will be prepared for a rewarding retirement.

How? Companies have used pre-retirement interviewing, individual counseling, group lectures and discussions, global education, house organ articles and global articles distributed through the usual channels.

Many firms deliberately abstain

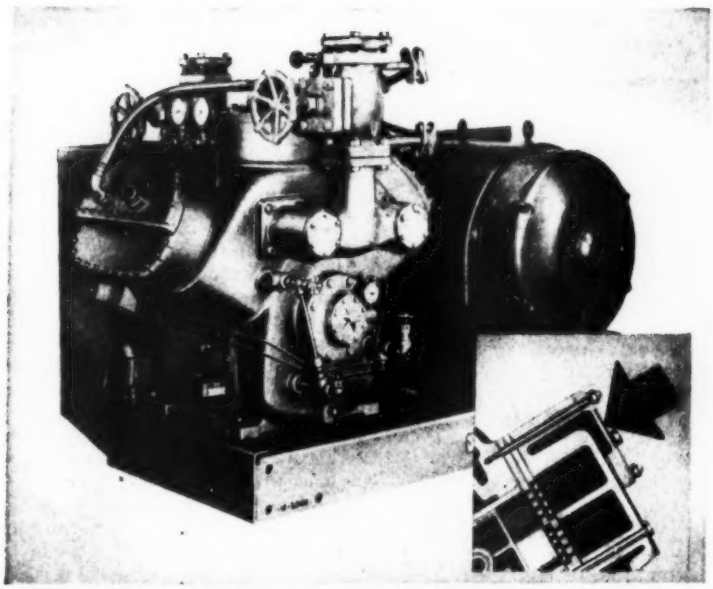
Expectation of Life and Mortality Rates United States, 1950

Age Years	Expectation of Life In Years	Mortality Rate Per 1000
	Total Persons	Total Persons
At Birth	68.4	29.2
10	61.0	.5
20	51.5	1.3
30	42.2	1.8
40	33.1	3.6
50	24.7	8.7
55	20.9	13.0
60	17.3	19.6
61	16.7	21.2
62	16.0	22.9
63	15.4	24.5
64	14.7	26.2
65	14.1	27.9
69	11.8	38.0

Source: Statistical Bureau of the Metropolitan Life Insurance Company from the abridged life table prepared by the National Office of Vital Statistics, Department of Health, Education and Welfare.

For more data on advertised products, use Readers' Service Cards, last page.

Look at all the features of Worthington's new high-speed ammonia compressor



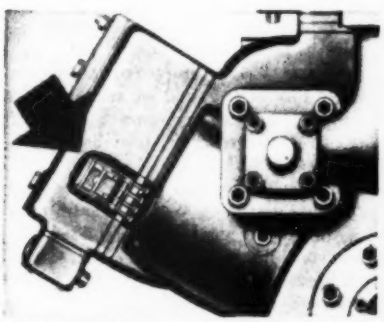
IMPROVED INTERNAL MANIFOLDING—cool suction gas completely surrounds the cylinder walls, providing longer valve life and increased overall efficiency. All passageways between suction discharge and shutoff valves are cast integrally within the crankcase, eliminating outboard fittings. Cross section shows water jacketing on one of the cylinders.

High operating efficiency and lighter weight make this modern unit the talk of the industry

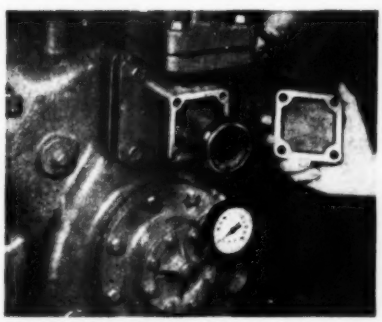
These lightweight, compact Worthington ammonia compressors have the same high operating efficiency and versatility as their lower speed counterparts.

Ranging in capacities from 18 to 150 tons, the new units can be used as high-stage or booster machines.

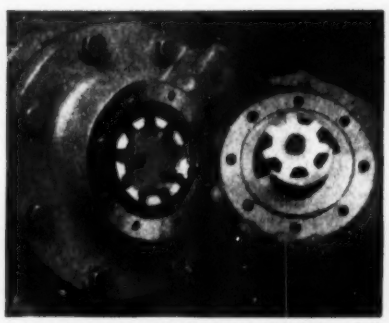
Get in touch with your nearest Worthington district office for more facts about these rugged compressors. Or write to Worthington Corporation, Air Conditioning and Refrigeration Division, Section A.3.56, Holyoke, Mass.



ELECTRIC UNLOADING—a new achievement in variable capacity control. You can start compressor with a normal torque motor; power consumption is automatically balanced against load. Separate unloader units allow easy maintenance . . . no oil or gas pressure lines to worry about.



NEW SUCTION MANIFOLD, with cover plate over suction strainer inlet, allows easy removal of the suction gas strainer for cleaning, without disturbing any of the pipes, valves or other parts. The strainer is unique in that it fits entirely within the crankcase manifold, requiring no additional space.



NEW FORCE-FEED LUBRICATION SYSTEM — full pressure, positive lubrication, regardless of rotation. A new rotary oil pump, driven directly by the crankshaft, eliminates complicated and noisy gear trains. Oil is filtered through a strainer in the crankcase for protection of pump and other moving parts.

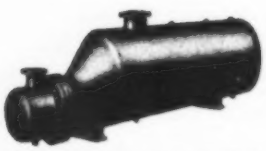
A.3.56

WORTHINGTON

CLIMATE ENGINEERS TO INDUSTRY, BUSINESS AND THE HOME

For more data on advertised products, use Readers' Service Cards, last page

WHAT'S YOUR PROBLEM?



EVAPORATING

Whitlock Type KR Reboiler — for conventional evaporation service. Tube bundle positioned low in shell — minimizes shell size. Design properly considers heat flux, boiling rates, vapor disengagement, fouling, etc. Write for Bulletin 130.

CONDENSING

Whitlock Type ST Exchanger — floating tube sheet (split ring) construction. Longitudinal split flow baffle design for optimum vapor distribution over condensing surface. Also adaptable to cooling and heating services. Write for Bulletin 250.

HEATING

Whitlock Type S Heater — straight tube, floating head (pull through) type. Designed for easy access to tube bundle . . . for simple maintenance. Particularly applicable to heating of dirty, fouling liquids. Write for Bulletin 250.

COOLING

Whitlock Type SG Cooler — outside packed (lantern gland) rear closure. Avoids danger of interleakage through gasketed joint. Fabricated of stock components to standardized details . . . available for wide range of oil and water cooling requirements. Write for Bulletin 122.

Whatever the type of service, there's a Whitlock Heat Exchanger that's right for the job. Our engineering, designing, manufacturing, and testing facilities are at your disposal.

Write for descriptive Bulletins, or send specifications on your particular requirements. **The Whitlock Manufacturing Co.,** 75 South St., Hartford 10, Conn. In Canada: Darling Brothers, Ltd., Montreal.

WHITLOCK'S YOUR ANSWER

As Management Sees It . . .

from too specific or individual consultation. They feel "there is a definite limit to corporate participation in personal matters." The company helps, advises on request and provides general information. Again, the method should be suited to the techniques found effective for other communication. It is unwise to single out the older worker problem, emphasizing its importance to the possible detriment of other matters.

What? Socony-Vacuum Oil Company, which has considerable experience, covers these subjects in its pre-retirement interviews and discussions:

Employe benefits: Sick leave, insurance, disability and annuity policies as applied to the individual.

Medical findings and advice as to current work and future care.

Determination of personal interests and hobbies to suggest later opportunities.

Plans for retirement, including financial needs, living costs, proposed activities in the community and other later life problems.

Understandably, personal and family relationships are generally not discussed. General information is afforded and arrangements may be made for specialist aid, depending on the company view of its employe program.

After Retirement—Some firms continue interest in employes after they leave. Marshall Field, Chicago department store, follows the practice of retire and rehire, calling back pensioned workers for one or two months work a year in rush seasons. Production plants engaged in seasonal work try to maintain contact with retired workers to insure a labor reserve when needed.

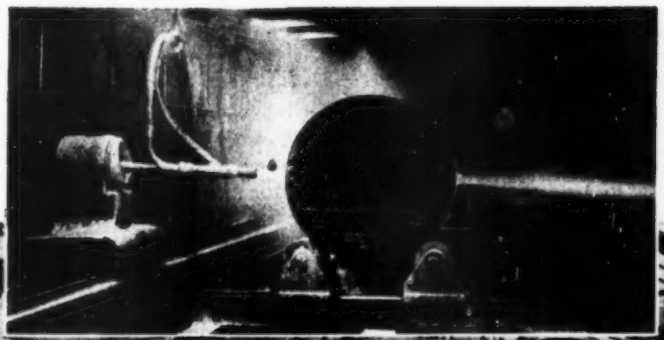
Almost all companies with established employe communication programs keep pensioners on the list to receive house organs, invitations to company picnics and affairs and even extend regular employe privileges and discounts to ex-employes.

Trends—The rapid rise in interest suggests that the wide-awake company must consider broadly its employe relations program. Give special, but not exclusive, attention to maintaining older workers to the mutual benefit of employer and employe; give further attention to preparing employes, through careful guidance, for their after-work lifetime.

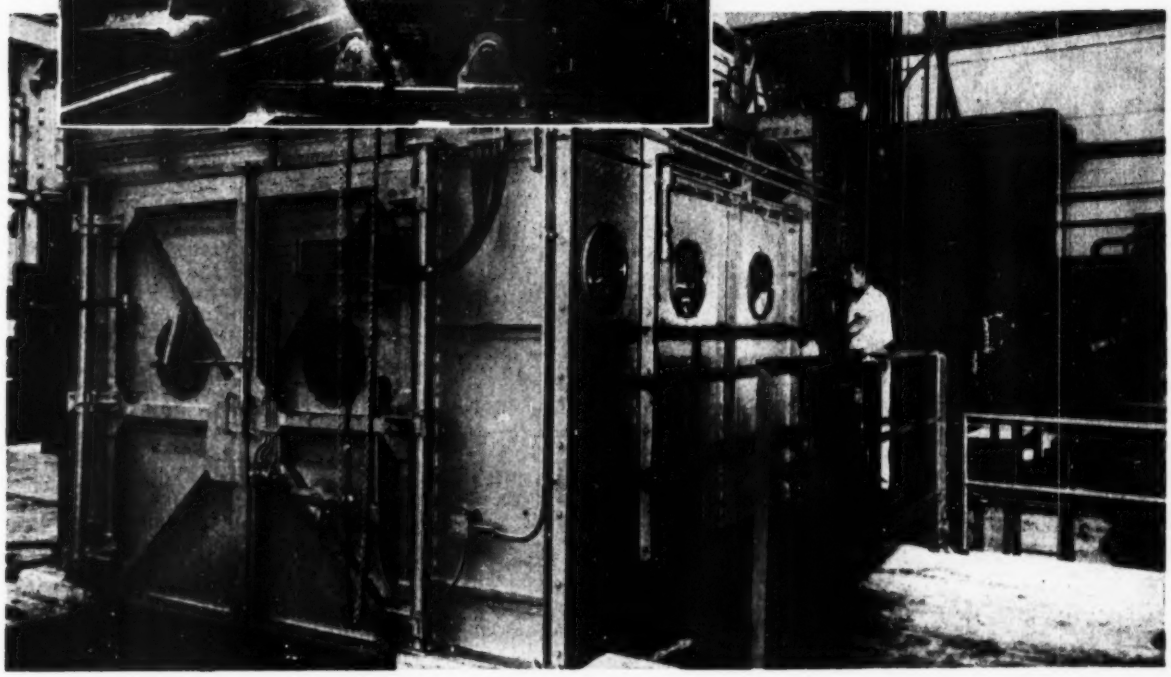
Companies which have adopted plans have testified that they pay off in increased profit, in satisfied work force, in better community relations.

For more data on advertised products, use Readers' Service Cards, last page.

A NEW and far more efficient method of cleaning HEAT EXCHANGERS



* it effects significant savings in cleaning time
* it does a thorough cleaning job
* it materially promotes operating efficiency



THE WORLD'S FIRST HYDRO-BLAST TUBE BUNDLE CLEANING SERVICE.

Hydro-Blast is a method of sandblasting, using water at 1600 PSI in which sand is entrained. Either square or triangular pitch bundles can be cleaned quickly and efficiently. Both the tube and shell side of the bundle is cleaned. Hydro-Blast combines abrasive cleaning with the mining effect of high velocity water.

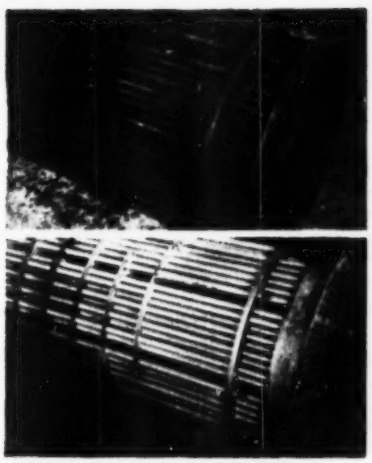
The 60-gpm carriage-mounted gun pictured above is operated to direct a high pressure stream completely through the bundle, cleaning the innermost tubes. Insides of tubes are thoroughly cleaned by mechanically adjusted guns mounted in the end doors of the Hydro-Blast Unit.

For greater exchanger unit efficiency, use our Hydro-Blast Service. **Ohmstede** picks up and delivers.

For service call:

OHMSTEDE MACHINE WORKS

Telephone 4-6376 Beaumont, Texas



PICTURED IS THE SAME TUBE BUNDLE BEFORE AND AFTER HYDRO-BLAST CLEANING!

For sales write: **OHMSTEDE CO., INC.** P. O. Box 1288, Beaumont, Texas.

4½" DIAL THERMOMETERS

Made in 3 types to suit any requirements. Rigid stem, wall or flush mounted, 11 inches of scale reading. Interchangeable with standard industrial separable sockets. Stem can be placed at any angle and case can be rotated to any readable position.

PALMER
MERCURY ACTUATED
Temperature Indicating Instruments

RECORDING THERMOMETERS

Twelve inch die-cast aluminum case with black or white wrinkle or satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 +950°F or Equivalent in °C.

INDUSTRIAL THERMOMETERS

Red-Reading Mercury —Extruded brass case — chrome finish. Ranges —40 + 950°F or Equivalent in °C.

RED-READING MERCURY LABORATORY THERMOMETERS

Thoroughly annealed for permanent accuracy. Complete line A.S.T.M. and fractional division types.

FOR COMPLETE INFORMATION WRITE FOR CATALOG 200 G

PALMER
THERMOMETERS, INC.
Cincinnati 12, Ohio • MElrose 1500

As Management Sees It . . .

The Courts Say . . .

in recent insurance cases

Shelton

This column is to inform—not advise. It presents the current trend in legal thinking on insurance cases. The law varies from state to state and its application depends upon the facts of the particular case. Do not attempt to apply it without consulting your attorney.

Joseph M. Shelton, Attorney at Law, Dallas

That insurance carrier was charged with correctness of medical report made by employer's doctor

EMPLOYE was examined prior to employment by a certain doctor regularly used by employer. Employe suffered an injury to his back and was treated by the same doctor, who told him he would be all right in a couple of weeks. Insurance adjuster later contacted employe and exhibited a carbon of a written medical report of the doctor, stating that employe would be all right. Employe signed a settlement agreement which he sought to set aside some 3 or 4 years later on the basis of fraud in the procurement of it. The trial court instructed a verdict in favor of the insurance carrier. The employe appealed.

The court said that the use of the employer's doctor's oral opinion and his written opinion to influence the settlement was in effect an adoption by the insurance carrier of the employer's doctor and made the doctor's statements binding upon it. The carrier was charged with the correctness of the report and the evidence on the trial raised an issue as to the correctness which was for the jury to determine. The court was in error in instructing a verdict for the carrier.

—Vinyard v. Texas Employers Ins. Ass'n.
263 SW 2d 675 (Tex. Civ. App. Dallas, 1953)

That employe must prove exposure to greater hazard than general public when a victim of heat stroke

EMPLOYE suffered a heat stroke or heat exhaustion while working on a job as a carpenter's helper. He claimed to have been permanently injured about the head, neck, arms and entire body as a result. On trial to a jury it was found that employe was suffering from permanent injuries which occurred while on the job in the course of his employment. The insurance company appealed, claiming the employe had failed to show he was subjected to a greater hazard from the act of God than was the general public.

The Texas Court said that the employe had, in effect, claimed his injury was caused by an act of God and it was incumbent on him to show that he was engaged in the performance of duties which subjected him to greater hazard than ordinarily applied to the general public.

—Traders & General Ins. Co. v. Ross
263 SW 2d, 673 (Tex. Civ. App.—Galveston, 1953)

That employe on plant construction was not a casual employe

EMPLOYE had worked for Defendant regularly for six months as a general laborer in a plant doing anything a common laborer could do. At the end of that time, he was laid off because of slack business. Employe was called back to help with some specific construction work about the plant. While so occupied, he suffered an injury to his back. Employer denied compensation on theory that construction work was not in the usual course of Employer's business.

The Tennessee Court said the rule upon which the employer relied was not to be extended to regular and general employes about a plant in connection with its usual business who happen to be at the time of the accident engaged, under supervision and direction of employer, on work of a repair or construction character.

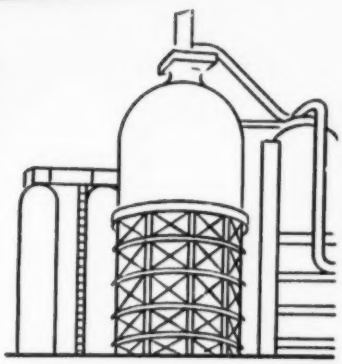
—Rhyne v. Lunsford
263 SW 2d 511 (Tenn. Sup. Ct., 1953)

For more data on advertised products, use Readers' Service Cards, last page.

LOOKING UP *inside a refractory-concrete-lined Universal Oil Products cat-cracking regenerator where the primary cyclone takes in abrasive catalyst particles.*

Refractory Concrete Lining

Withstands high temperatures, corrosion . . . abrasion in cat-crackers



At operating temperatures of 1000° F., millions of catalytic particles constantly abrade linings inside fluid catalytic cracking systems. For this rugged job, many engineers find that refractory-concrete linings have what it takes to give long, trouble-free service at low cost.

Special industrial concretes, made with Lumnite* calcium-aluminate cement, are available to fit a variety of needs throughout the refinery. They offer all the placing convenience of regular concrete mixtures plus a combination of corrosion and heat resistance.

Lumnite cement, with suitable aggregates, produces concretes that withstand temperatures up to 2600° F., resist corrosion and, with suitable aggregates, provides insulation.

Installation is fast and efficient. Down time is cut to a minimum. Special industrial concretes are quickly placed by cement "gun," trowel or pouring, and reach service strength in 24 hours.

FOR CONVENIENCE you may prefer to make these special industrial concretes with prepared castables (Lumnite cement plus aggregates selected for specific temperature and insulation needs). They're made by refractory manufacturers and sold through their dealers. For more information, write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

WHERE TO USE SPECIAL INDUSTRIAL CONCRETES:

- **Tank linings and pipe linings for protection from sour crude.**
- **Linings in regenerators; fractionating columns; cracking, vacuum distillation, and alkylation units; stripper and flash towers; accumulators and soakers.**
- **In heaters, furnaces and coking ovens.**
- **Stack and flue linings.**
- **In ducts and furnace foundations.**

**"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

PR-L-87

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

UNITED STATES STEEL HOUR—Televised alternate weeks—See your newspaper for time and station.

For more data on advertised products, use Readers' Service Cards, last page.

SOLVING MANY PROBLEMS!

Perhaps your industry has a particular process that requires a superior reducing or bleaching agent, preservative, antichlor, pH control, or neutralizer. Tennessee's highest quality Sulphur Dioxide will fit the need. In most operations, the use of this chemical (SO_2) with its manifold uses results in more efficiency and increased economy. We can supply Tennessee's highest quality Sulphur Dioxide in cylinders, ton drums, tank cars, and tank trucks. Let our technical experts show you how you might employ it to your greatest advantage.

SULPHUR-DIOXIDE
HIGHEST QUALITY
SO_2

- Cylinders
- Ton Drums
- Tank Trucks
- Tank Cars

Samples, Specifications and Detailed Information on Request.

TENNESSEE TC CORPORATION

617-29 Grant Building, Atlanta, Georgia

As Management Sees It . . .

Better Health for Executives

Part III

Your Eating Habits

Reeve

Dr. B. B. Reeve
Medical Director, Standard Oil Company (Indiana)

THE EXECUTIVE is the victim of his position.

Too often, you are wined and dined to death.

You cannot avoid going to interminable luncheons, dinner meetings, and cocktail parties.

Wherever you go, people who want to do business with you, and people with causes they want you to support, will take you to the so-called best places to eat in town. Men who work under you will plan where to take you, their "boss." They all seem to know the food you like best.

You're likely to become the best—but worst—fed man in the world. That, in spite of the fact that you know the truth in the old saying, "We dig our graves with our teeth."

It is essential for you to know—and observe—some of the fundamental facts of proper diet. Overeating and drinking, and improper eating, are known definitely to have detrimental effects on health. The age, the activities, and the medical history of each individual determine the amount and type of food in his proper diet. As a person grows older and less active, his body needs more protein, less fat and carbohydrates.

It is now recognized that each individual needs about 15 to 20 calories a day for each pound of body weight, varying along with the activities performed.

The end result of overeating is obesity. Obesity takes its toll by shortening an individual's life in direct proportion to the amount of overweight. Insurance companies, finding this fact demonstrated in their statistical experience, are leading the fight against obesity.

The nation has become obesity conscious. It should!

To be conscious of the effect of obesity is not enough.

The cause of overweight is excess eating.

The cure is eating less.

For the obese person, control of his excess in eating can be infinitely more difficult than learning the sheer facts about it. It is now known that a strong emotional factor is often involved in a person's overeating. Eating in itself seems to this person to be some sort of relief mechanism, related to an emotional tension he has built up. Until he is able to control—and controls—this emotional factor, this individual will not be successful about reducing.

If you are overweight, it may be enough to learn the fundamentals of foods and their caloric values. These facts may be learned easily from the books that are available in layman's language, yet accurate, or from your physician. If this is not enough, you should counsel with your physician about the problem of your overeating.

The problem is immediate, not to be given your attention just any time when you get around to it. Overweight individuals have a far greater tendency than people of normal weight to develop degenerating diseases, such as high blood pressure, diabetes, and vascular diseases.

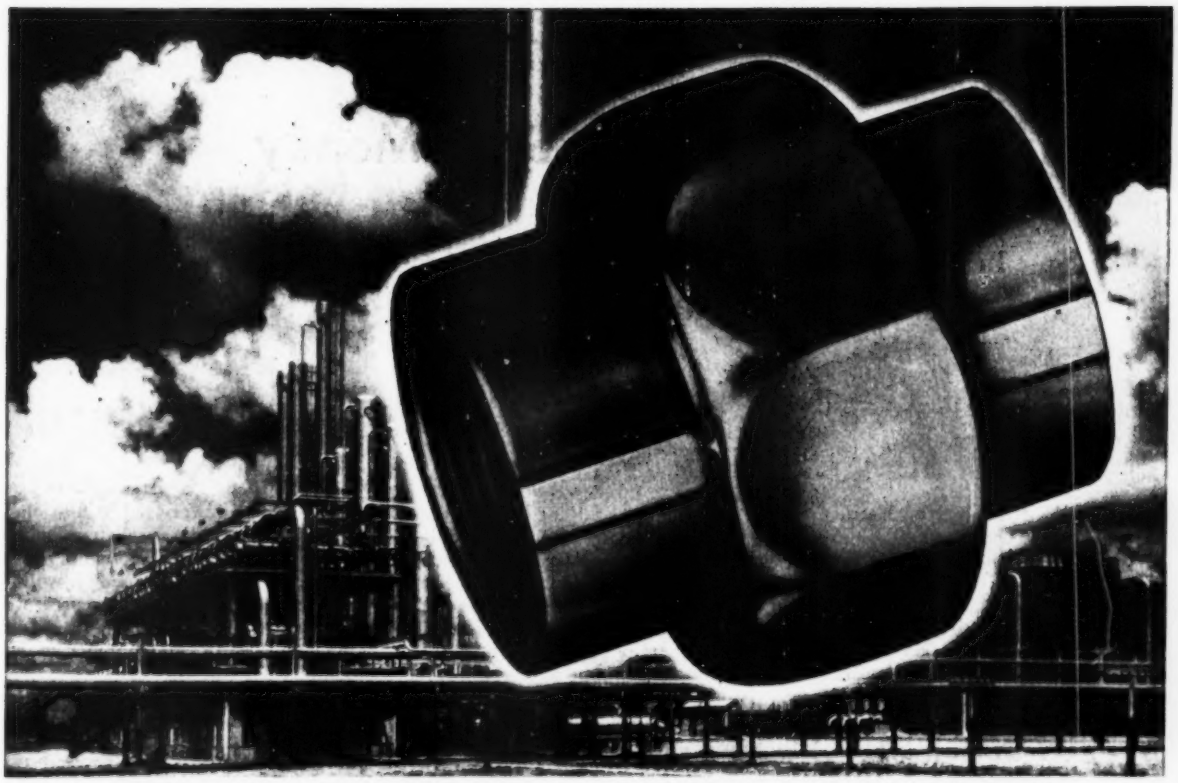
Perhaps your health doesn't seem particularly important to you. You may think you have other, more pressing responsibilities. However, it is one of your responsibilities as an executive to remember that your company has a considerable investment in you, and that it is a business essential that you conserve your health.

As an executive, it's up to you to avoid the pitfalls of improper eating.

If you eat moderately, you'll maintain better health.

(To be concluded in an early issue.)

Note: The author is dealing in generalities. He is in no way offering relief for, nor suggesting treatment for specific ailments.



Designed Especially for the Oil and Gas Industries, Rockwood cold-forged steel Unions have been tested and listed by Underwriters' Laboratories, Inc., for use in handling flammable liquids and gases.

More Strength where you need it most!

Potential trouble spots get tops in protection when you use Rockwood Unions.

Every detail of their new design is planned to increase your safety margin and cut replacement costs. The breaking load of the 3" size, for example, is 118,000 lbs., for greater resistance to jarring, vibration, expansion and construction-shock. This extra tensile strength is evenly distributed, also, thanks to over-all balance which makes each of the three parts equally rugged.

The non-corrosive seats are double-locked in place under pressures of 100,000 and 400,000 lbs. Being integral with the Union they can't work loose. And their plug-type ball-to-cone construction eliminates sharp corners and edges. You get quick, easy alignment.

Cold forging enables making these seats of either stainless steel or Moly 341, which means no possibility of corrosion at the seat joint. In addition, all Rockwood Unions are "Rockwoodized" against corrosion by a special coating process — and absolute interchangeability of parts completes the list of solid advantages you get when you specify Rockwood Unions. For full information, write Rockwood Sprinkler Company, 102 Harlow Street, Worcester 5, Mass.

Checked For Extra Strength. Determining tensile strength is a typical feature of Rockwood's thorough quality control. Unions are taken regularly from production and tested in this machine. Average breaking loads for the 1", 2" and 3" sizes are 24,000, 82,000 and 118,000 lbs., respectively — extra strength for toughest service.

Special Non-Corrosive Seats are a big Rockwood advantage. Specify Rockwood Type 602 Union with two stainless steel seats — or Rockwood Type 603 Union with two Moly 341 seats.

ROCKWOOD

ROCKWOOD

SPRINKLER COMPANY

MANUFACTURERS OF THE MOST COMPLETE LINE OF STEEL UNIONS ON THE MARKET

WORCESTER 5, MASSACHUSETTS

Officials Speed Reading, Save Money

Brief course in Gulf Oil's own offices teaches executives to read with twice the efficiency of the average American adult.

Mildred Hicks, Student Services Division,
University of Houston,
Houston

A SHORT COURSE of instruction in their own offices has taught a group of Gulf Oil Company officials to read with twice the efficiency of the average American adult.

The average American reads at 225-250 words per minute with 75 percent comprehension. His reading efficiency score, found by multiplying words per minute by percent of comprehension and dividing by 100, is 170-185. Yet most of these average Americans can be trained quickly and easily to read from 50 to 100 percent faster with ever greater comprehension.

Business executives spend an average of two or three hours a day reading reports, memos, correspondence and technical data. If their time is worth $5 an hour, it is costing from $50 to $75 a week for each of them to read the material that crosses his desk. And if this reading time were cut in half, the savings would be substantial.

Top Personnel Used—These facts prompted J. S. Trail, executive in the Budget and Statistics and Organization department, to ask Dr. A. J. Pellettieri, director of the University of Houston's Reading Clinic, to conduct a reading program in the Gulf Building.

Dr. Pellettieri suggested that the top personnel of Gulf be invited to participate, since these employes, he felt, would profit most from training. The two agreed on a later planning session which was to include John Ligon, Jr., coordinator of Employment Information, and Ross Carr, coordinator of Safety and Training.

Fourteen officials accepted Gulf's invitation to become "better than average readers."

While the class was being formed, facilities were being prepared for it. A projection room for showing films and film strips, and a laboratory-classroom, adequately lighted and containing tables, chairs, and bookshelves, were provided in the Gulf Building. Dr. Pellettieri then moved in his equipment; "pacers" or accelerators for controlling the speed of reading, flash meters for increasing the speed and span of perception, and a library of popular and technical books and magazines, in addition to the reading films.

Experience had taught Dr. Pellettieri that a flexible schedule for these busy men, many of whom traveled extensively, was more workable than the strict class schedules maintained on the University campus. Accordingly, he arranged to provide two lab periods per week from 3:30 to 5:30 p.m., and one weekly theory session from 4:30 to 6:30 p.m., to extend over a 12-week period. Each class member was then expected to attend one of the lab sessions (though he might attend both), and a portion of the theory session each week—at least 45 minutes at his most convenient time.

Dr. Pellettieri conducted the theory classes, and assigned Mrs. Elizabeth MacNaughton, Reading Clinic staff member, to supervise the laboratory work.

Read for Content—The first class meeting was used to orient members in the basic principles of reading techniques. It was determined just how effectively each member was presently reading; speed, comprehension, amount of recall, and number of eye fixations per line. Because physiological factors strongly influence reading ability, members were also screened for physical disabilities, particularly for impairments of sight or hearing. From the beginning, Dr. Pellettieri urged class members to read for *meaning* or *content*, rather than for the purpose of gaining speed, and emphasized the fact that increased reading speed was a natural result of the course, not one to be sought at the expense of comprehension.

In following lab sessions, activities included the viewing of films and film strips. These were presented at slow beginning speeds, with only a few words at a time flashed on the screen. Gradually the speed was increased and longer phrases or whole lines were shown. Flash meters were used for training in perception span. Their function is somewhat similar to that of the reading films. Training was begun by first flashing cards contain-

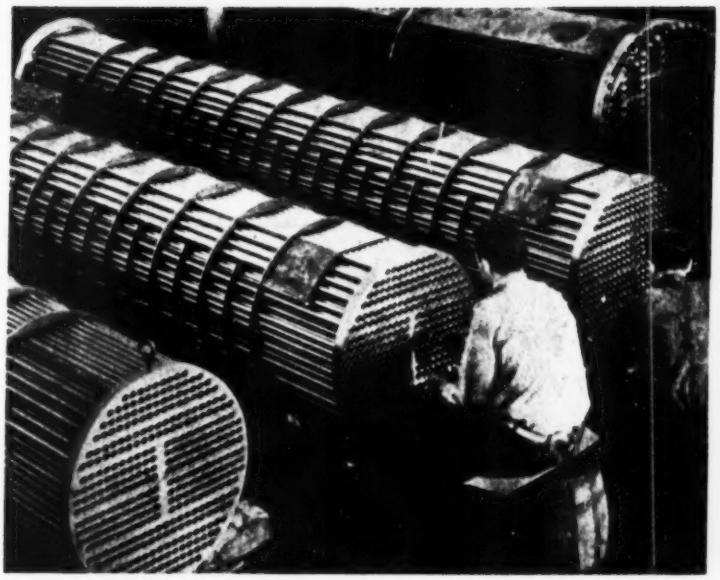
TABLE 1

Here's How Group's Reading Skill Improved

IDENTIFICATION	Speed W.P.M.		Comprehension Percent		Reading Efficiency	
	Before	After	Before	After	Before	After
A	177	516	70	85	124	439
B	277	401	70	100	194	401
C	292	482	60	70	175	337
D	277	433	75	85	208	368
E	240	645	75	75	180	484
F	252	433	70	75	176	325
G	433	926	65	75	281	695
H	197	442	85	90	167	398
I	230	570	65	80	150	456
J	264	835	80	75	211	626
Total	2639	5683	715	810	1866	4529
Average	263.9	568.3	71.5	81.0	186.6	452.9
Gain	....	204.4	....	9.5	....	266.3

Troubled by corrosion from Naphthenic Acids?

Try Inconel



As a result of plant corrosion tests of South American distillates containing naphthenic acids, more than 20,000 pounds of Inconel were used for the 1,085 cold drawn seamless tubes in these 3 heat exchangers. Tube sheets are of Inconel plate 30 1/2" and 34 1/2" dia., 2-1/16" and 2-3/16" thick. Photo courtesy of FOSTER WHEELER CORP., New York.

CORROSION TEST DATA

1. Test spool exposed in bottom of primary fractionating column of topping unit. Naphthenic acids in heavy distillate. Neutralization value of distillate 2.5 mg. of KOH per gram. Sulfur content 2.4%. Temperature: 500° F. Duration of test: 174 days on sour crudes, 119 days on sweet crudes, 24 days off stream (spool in column a total of 317 days).

	Average Corrosion Rate
Monel	**0.006 ipy***
Nickel	**0.005 ipy**
Inconel	**0.003 ipy**

2. Spool exposed between trays 6 and 7 of secondary fractionating column on high vacuum unit. Naphthenic acids in heavy distillate. Neutralization value of gasoline 2.0 mg. KOH per gram. Sulfur content 1.7%. Temperature: 500° F. Duration of test: 59 days.

	Average Corrosion Rate
Monel	**0.0012 ipy**
Nickel	**0.0007 ipy**
Inconel	**0.0007 ipy**

3. Spool exposed in a second stage separator of a combination unit handling cracked petroleum gas oil from Monaca crude (naphthenic base). Sulfur content 1.27%. Temperature: 760° F. Duration of test: 18 days.

	Average Corrosion Rate
Monel	**0.238 ipy**
Nickel	**0.232 ipy**
Inconel	**0.0074 ipy**

4. Spool exposed in a first stage intercondenser of a combination unit handling cracked Monaca and Quiriquire crudes (naphthenic base). Sulfur content: 1.1%. Temperature: 800° F. Duration of test: 131 days in Monaca crude; 65 days in Quiriquire crude.

	Average Corrosion Rate
Monel	**
Nickel	**
Inconel	**0.0092 ipy**

**ipy—inches penetration per year of continuous exposure.*

***Specimens originally 0.031 inches thick were completely destroyed during test period.*

Naphthenic acids in the high temperature distillates were complicating the corrosion problems of a certain South American refinery.

So the problem was taken to Inco. Using Inco test spool specimen holders, plant studies were undertaken to determine the material best suited for corrosion resisting heat exchangers.

As a result of the findings summarized at *left*, Inconel® condenser and heat exchanger tubes were installed in 1940. They are still in service.

Nickel and Monel® are suitable for distillates containing naphthenic acids where temperatures do not exceed 500°F. But where temperatures exceed this, Inconel provides better resistance to possible sulphur attack and oxidation.

Like Nickel and all high Nickel Alloys, Monel and Inconel are strong and tough, yet they are readily fabricated and welded. No after-treatment is required to develop maximum corrosion resistance.

Both Monel and Inconel are supplied in all commonly used mill forms—plate, sheet, strip, rod and seamless tubing. Inconel can also be had as Inconel-Clad Steel and it can readily be welded to steel to make linings.

For help on your heat exchanger corrosion problems, write Inco's Corrosion Engineering Section. Be sure to give full details.

It is advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
INCONEL® • INCONEL "X"® • INCONEL "W"® • INCOLOY®
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For more data on advertised products, use Readers' Service Cards, last page

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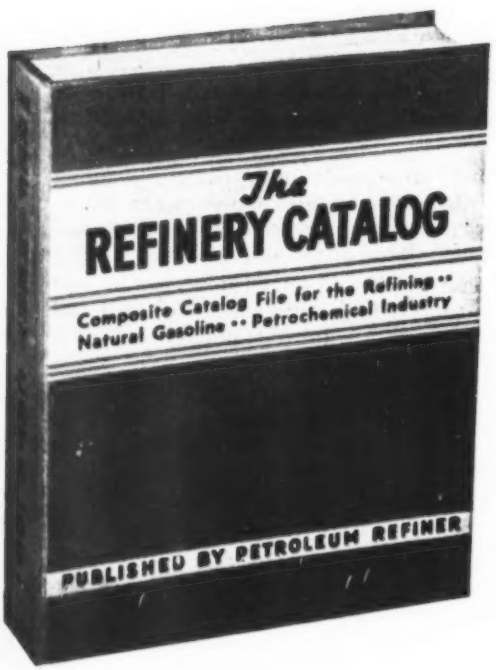
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Composite Catalog File for the Refining •• Natural Gasoline •• Petrochemical Industry
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REFINERY CATALOG

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ing only one or two words or symbols for the reader's recognition, then more, and finally entire lines. The pacers, used for accelerating reading speed, also help to reduce regression and increase attention span. This machine, operating at adjusted speeds, is equipped with a screen which moves down over the reading material, uncovering one line at a time. There was also "free reading" of technical and popular material, and "reading for detail" of standard prepared tests.

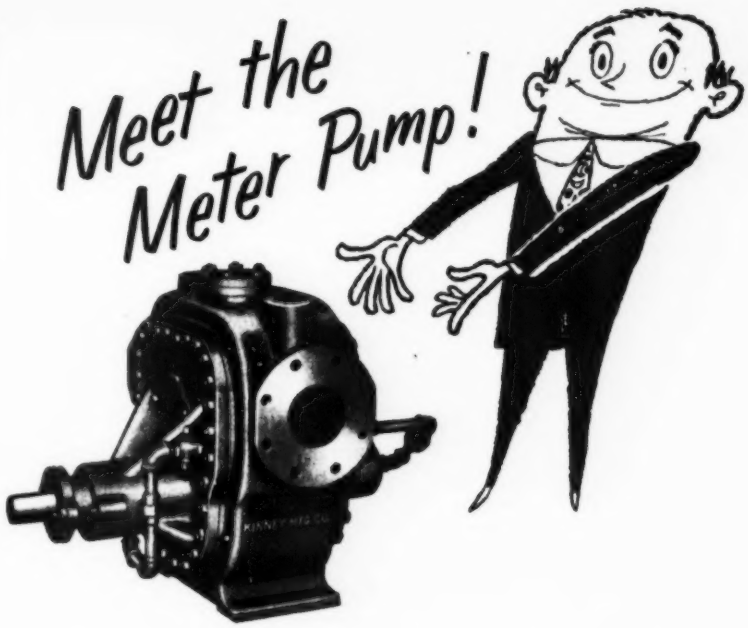
Each of these activities was scored for comprehension, accuracy and speed. Class members kept their own scores and competed against previous records rather than against each other.

Individual Problems Solved—Theory sessions brought to light individual reading problems. One class member whose speed and comprehension scores had leveled off, said after taking a test, "I just don't seem to get the hang of this." Dr. Pellettieri suggested that he translate the words into units of thought, which he did, and again his scores were moving upward.

Another reader complained, "I read through a page or two, and then have no idea of what I have been reading." In such instances the instructor watches for physical distractions—"looking away," poor posture, unusual bodily movement—of which the reader may not be aware, and calls them to the attention of the reader. He also suggests that the reader might correct his difficulty by reading several lines at a time and recalling the content, then reading a paragraph at a time following with recall, next a page at a time, and on to the full report.

The fastest reader of the first session covered 433 words per minute and the slowest 177. For the group as a whole, the beginning average was 264 wpm. At the end of the course the fastest reader was going at a 926-wpm clip, and the slowest at a good 400. The group average had gone up to 568. See Table 1.

Dr. Pellettieri is frequently asked if such spectacular gains are not easily lost. He recently retested a similar group and found that after seven months time had elapsed, they still scored 85-90 percent on reading comprehension, speeds originally at 225-250 wpm were still at 500 wpm or more, and retention was high. The greatest gain these men felt they had made and kept was in their continuing awareness of reading ability—a conscious effort to read with greater skill.



In thousands of installations, the Kinney Model SD Rotating Plunger Pump "doubles in brass": (1) it pumps viscous fluids efficiently and economically, and (2) it serves as a combined meter and pump due to its unusually high volumetric efficiency.

This is important to the process industries, for proportioning liquid components, and where a fixed percentage of viscous liquids must be maintained. The Kinney SD Pump is also unbeatable for pumping viscous materials in storage and bulk plants. Furthermore, the Kinney SD Pump is a "miser" when it comes to maintenance. There are no valves, blades, springs, or vanes to clog up or get out of order . . . everything about this pump is designed for long, continuous, dependable operation.

SD Pumps are available in capacities from 2 GPM to 3000 GPM — steam-jacketed in most sizes.

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☐ Please send Bulletin L51 describing the complete line of Kinney Liquid Pumps.

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For more data on advertised products, use Readers' Service Cards, last page.

What Suppliers Are Doing . . .

Davison Makes Changes In Research and Development

In a reorganization of The Davison Chemical Corporation's Research and Development division, Dr. P. L. Veltman has been advanced to director of Research and Development. He was formerly manager of the Curtis Bay, Baltimore, Md., Laboratories.

Veltman

Other appointments resulting from the revision: Ralph E. Hope, formerly manager of Research Engineering, has been made an assistant director, his duties including management of the laboratories. L. L. Baral has succeeded him as manager of Research Engineering. W. K. O'Loughlin has also been named an assistant director. He was formerly manager of the Development department, in which position he is succeeded by O. D. Myrick. Edwin M. Glocker, formerly staff assistant to the vice president in charge of the division, has been made manager of the Research Statistics department, a new post, and Luther O. Young, manager of the Application Research department, another new post. C. D. Helm and A. J. Antonious have become staff assistants to the division vice president.

CEC Instruments Moves Southeastern Regional Office

CEC Instruments, Inc., subsidiary of Consolidated Engineering Corporation, has transferred its southeastern regional offices from Washington, D. C., to Atlanta, Ga. A Washington district office operating under the jurisdiction of the new regional headquarters will continue to afford direct liaison between customer and manufacturer in Maryland, Virginia, West Virginia and the District of Columbia.

Charles C. Snider will continue to direct sales and service operations for the company in Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Florida and Mississippi from the new headquarters.

Atlantic Approves O'Donnell For Catforming Construction

J. P. O'Donnell Corporation, New York and Beaumont, Texas, has been approved by The Atlantic Refining Company for the mechanical design and construction of Atlantic catalytic reforming units.

Termed catforming by Atlantic, the process is a continuous, fixed bed process which functions to produce high-octane motor fuel at high yields.

Carver Pump Assigns Lane To Midwest to Head Regional Sales

L. C. Lane has been appointed regional sales manager of Carver Pump Company's Midwest operations. He will maintain contact with Carver's distributors and sales representatives conducting sales meetings to keep the representatives abreast of the company's operations and to assist in general the promotion of Carver pumps.

Lane

A graduate of Purdue University, Lane will establish regional headquarters at West Lafayette, Ind.

Walton and Trumbower Will Head Dravo West Coast Office

Dravo Corporation, Pittsburgh, Pa., has opened a West Coast office in the Monadnock Building, San Francisco, Calif. It will be under the management of William A. Walton, who has been with Dravo since 1940. Frank S. Trumbower, who will join Walton in the San

Retubing 10,000 tube Turbo Condenser with special rigging and tools.

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Replacement Vapor Condenser Bundle for refinery ready for shipment.

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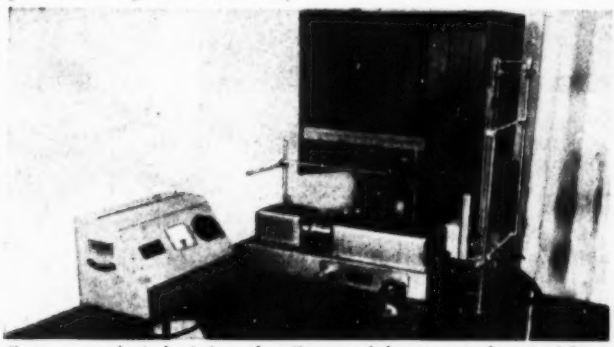
Controlling the Natural Gasoline Plant with Infrared Analysis

Infrared analytical methods, both in the laboratory and in the plant, can contribute greatly toward the over-all operating efficiency of the natural gasoline plant.

Infrared spectrometers installed in gas laboratories have proved to be more rapid and accurate than fractional distillation equipment and more economical than mass spectrometers. Typical applications are *purity checks* on finished products, *feed gas analysis, determination of proper temperature gradients* in fractionating columns, etc. (Refs. "Chemical Processing" and "Petroleum Processing," January 1954.)

In the plant itself, infrared analyzers will record continuously the concentration of a particular component in the refinery stream. They will *monitor feed gas, record moisture content, control depropanizers and de-ethanizers, warn of corrosive* or hazardous conditions and they may be used for many other analyses which are important in the overall efficiency of the plant.

Perkin-Elmer provides a complete range of laboratory and plant instruments that may be tailored for specific natural gasoline plant problems by our Application Engineering Staff. Let us show you how your plant operating efficiency may be improved through infrared analysis.



Cost per analysis by infrared at Cargray laboratory (above) of Panoma Corporation has been considerably less by infrared than by conventional methods.

FOR THE PILOT PLANT—*Model 14 Multi-Component Analyzer*— Continuously records the concentration of up to six components in a pilot process stream on a six-minute cycle. Ideal for tracking the effects of temperature, pressure, etc., changes in a pilot stream.

FOR THE PROCESS PLANT—*Model 98 BICHROMATOR* Analyzer* —For continuous control of liquid or gas streams. Records the ratio of any two wavelengths chosen. Thermostatted, enclosed in explosion-proof containers.

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WORLD'S LEADING MANUFACTURER OF INFRARED ANALYTICAL EQUIPMENT

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Suppliers . . .

Francisco office as territorial sales and service manager, has been associated with Dravo since 1942.

Diamond Alkali Announces Two Organizational Appointments

Two key organizational appointments at Diamond Alkali Company have been announced. C. A. Butler, Jr., director of engineering since 1946, has been promoted to the newly created post of director of commercial development. Loren Scoville, since 1951 vice president in charge of engineering, purchasing and operations for Jefferson Chemical Company, has been named to take over Butler's work as director of engineering.

Instruments, Inc., Purchases Telematic Gage Facilities

All patents, dies, fixtures, materials and trade-marks of Telematic Corporation, Chicago, have been purchased by Instruments, Inc., Tulsa. Manufacture, sales and service of the Telematic gage will be handled by Instruments, Inc., or its authorized sales representative.

Southern Engine & Pump Moves Reynolds to New Lafayette Post

R. H. (Dick) Reynolds has been appointed manager of Southern Engine & Pump Company, Lafayette, La. Reynolds joined Southern Engine & Pump Company in 1952 and served with the Houston office in the Engineering department prior to transfer to Lafayette.

DAY MAN ON THE JOB . . .

Experience Furnished Pitt-Chem. Users

Here's a regular service to users of Pitt-Chem's cold applied protective Coatings in the area served by the S. D. Day Company* that adds to the value of using these products. When you DEAL WITH DAY, one of his men is present to pass on his knowledge to assure you the best and most efficient application.

The Pitt-Chem. 100 Series cold applied Tar Base Coatings have an outstanding record in reducing maintenance costs for industrial equipment and structures; here are a few:

PITT-CHEM. 101 A versatile heavy duty coating that withstands severest corrosive conditions.
102 A thin, high gloss maintenance coating for steel and concrete surfaces.
103 Excellent protection for metal exposed to corrosive vapors, dilute acids and alkalies.
104 A fast drying high gloss coating that will not transmit taste or odor to water.
105 A water base coating with wide range of uses in the higher temperatures.

These coatings are stocked in Houston for immediate shipment. Engineering counsel, literature and prices are furnished through our Houston Office.

The Pipeliner's Friend says, "Formula 291 gives skin protection for those working where fumes may be toxic."

* Gulf Coast Distributor

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Mueller Co. Adds MacLean As Chief Products Engineer

Allen D. MacLean, formerly chief engineer of Chaplin-Fulton Manufacturing Company, has been named chief products engineer for Mueller Company. At the same time he retains a consulting position with Chaplin-Fulton.

MacLean

Well known in the gas industry, MacLean is the author of many trade journal articles and handbooks. During World War II he served as director of production for the U. S. Maritime Commission and again for one year during the Korean War. He began his career as a chief draftsman for a Cambridge, Mass., valve company.

New Elliott District Manager At Cincinnati Pictured Again

Raymond V. Thayer, the new Cincinnati district manager for Elliott Company, was incorrectly pictured in the February issue of PETROLEUM REFINER. His true likeness appears at right.

Thayer

Thayer, whose picture was to have accompanied the announcement of his advancement, joined Elliott in 1945 as a field engineer in the company's Cincinnati office. He had served in that capacity until his recent appointment. He is a native of Chicago and was graduated from Purdue University in 1941.

Continental Supply Honors Employes with Long Service

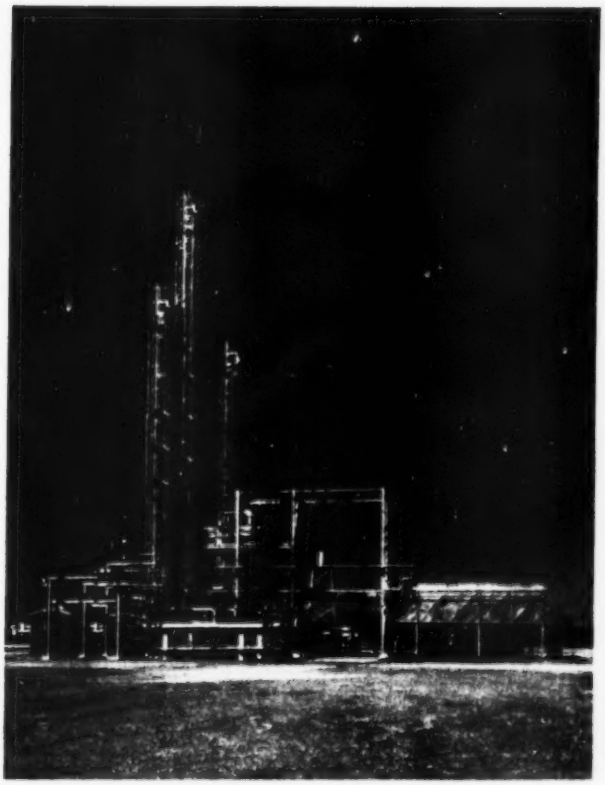
Twenty-six employes of The Continental Supply Company were honored recently at a service pin award dinner in Houston. Pins for 15 years and five years service were presented. This is the first year a pin has been awarded for 15 years service.

Those receiving pins for 15 years were: S. Q. Bates, D. F. Bell, D. P. Davis, E. E. Files, R. A. Gentry, R. F. Gregg, Raleigh Hortenstine, Jr., Tony Kovach, L. D. McNeill, Jake Voigt and E. E. Tyer, all of Houston; C. G. Cuthbertson and G. R. Runnels, Corpus Christi; G. W. Patterson, Alice, Texas; John Silhavy, New Iberia, La.; and W. E. Young, San Antonio, Texas.

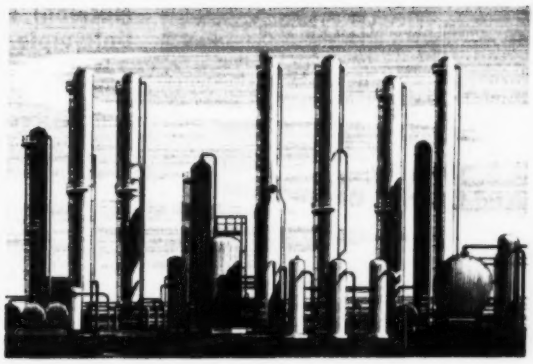
Industrial Relations Head Appointed at Laclede-Christy

Three appointments have been announced by Laclede-Christy Company.

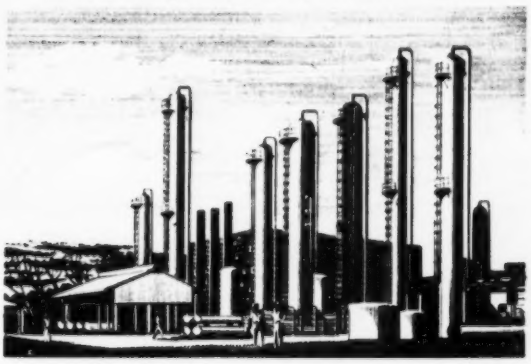
Russell C. Stone, who recently joined the company, has been named director of industrial relations and personnel. J. W. Rogers, formerly manager of Glass industry refractory sales, has been named to the newly created post of special glass refractory consultant. In the



Located near Ballinger, Texas, the above plant (designed, engineered and constructed by Fluor for Runnels Gas Products Corp.) recovers 85,000 gallons daily of LPG and gasoline.



Built by Fluor, this natural gasoline plant for Warren Petroleum near Lovington, New Mexico, processes 22 mmcf/d.



Fluor designed, engineered and constructed this natural gas absorption plant, crude stabilizer and crude topping plant, Colombia, South America, for Colombian Petroleum.

Three more natural gasoline plants by FLUOR

BRINGING THE TOTAL TO 28

Fluor has an impressive record in the design, engineering and construction of natural gasoline plants. Twenty-eight complete units have been built by Fluor, ranging in size from 18 to 185 mmcf/d capacity, with several more under construction. Almost double that number of existing gas plants have been expanded and modernized by Fluor.

Fluor has built virtually every type of field processing plant – gas absorption, pressure maintenance, cycling, gas treating (aqueous, glycolamine, glycol dehydration, desulfurization, diethanolamine, etc.), plus innumerable compressor stations on gas transmission lines. Fluor manufactured products are used extensively throughout the Natural Gas industry. These include cooling towers, Fin-Fan air-cooled heat exchangers, pulsation dampeners, mufflers and gas cleaners for liquid and solids removal.

With headquarters at Los Angeles and a Mid-Continent Division in Houston, Fluor is conveniently located to provide an integrated organization for the design-erection of a complete gas-gasoline plant or any phase of it. Fluor's metal fabricating shops at Paola, Kansas, are well equipped for all types of structural steel and plate work, for the prefabrication of pressure vessels and piping. For more information on Fluor's qualifications in the Natural Gas industry, write for Bulletin FC-RC-0.004.

BE SURE WITH **FLUOR**

THE FLUOR CORPORATION, LTD.
LOS ANGELES 22, CALIFORNIA

FOREIGN FACTS FLUOR, PARIS
FLUOR OF CANADA, TORONTO
FLUOR INTERNATIONAL, BEIRUT
FLUOR PERUANA, S.A., LIMA
HEAD WRIGHTSON, LONDON

ENGINEERS
CONSTRUCTORS
MANUFACTURERS

NEW YORK
CHICAGO
PHILADELPHIA
BOSTON
PITTSBURGH
SAN FRANCISCO
HOUSTON
BIRMINGHAM
TULSA

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

third appointment, R. N. Helmkampf, formerly assistant manager of glass industry sales, was promoted to manager of glass industry sales.

U. S. Steel Division Begins Lead Coating Distribution

U. S. Steel Supply division of United States Steel Corporation has begun distribution of a new type rust preventative lead coating known as Blakled. Neither a conventional paint skin nor a pigment ground into a vehicle, it is said to "fill in" the surface of steel and actually replace moisture and air on a steel surface.

National Tube Appoints Dalrymple to Credit Post

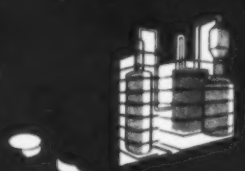
James P. C. Dalrymple has been appointed assistant treasurer, in charge of credits, of United States Steel Corporation's National Tube Division. He succeeds William R. Lenga, who has been transferred to the New York treasurer's office.

Kaiser Buys Myers Stock

Kaiser Steel Corporation has purchased approximately one-third of the common stock of Meyers Drum Company. The Meyers plant, with general offices in Oakland, is located on a 16-acre site at San Pablo, Calif., and has a daily capacity of 4000 drums and 10,000 pails.

Stauffer Chemicals for the...

Petroleum Industry



The Petroleum Industry must have reliable sources for heavy chemicals in the producing and refining operations. Stauffer has available for immediate delivery many of the chemicals needed by the industry, including sulphuric acid, muriatic acid, sulphur, caustic soda, and paraffin solvents. In petroleum processing and in the new and expanding petro-chemical industry Stauffer has kept pace and is prepared to supply industrial chemicals in any quantity.

With 43 plants and warehouses located in or near the petroleum centers, Stauffer has the complete facilities for a dependable source of supply.

Stauffer Products:

Aluminum Sulphate · Borax · Boric Acid · Boron Trichloride · Carbon Disulphide · Carbon Tetrachloride · Caustic Soda · Chlorine · Citric Acid · Copperas* · Cream of Tartar · Ferric Sulphate* · Fire Extinguisher Fluid · Insecticides and Fungicides · Muriatic Acid* · Nitric Acid* · Perchlorethylene · Potassium Nitrate · Rochelle Salt · Silicon Tetrachloride · Sodium Hydrosulphide · Sodium Silico Fluoride* · Sulphuric Acid · Sulphur (processed) for all uses · Sulphur-Rubbermakers · Sulphur-Insoluble (in CS2) (special-purpose rubber-making) · Sulphur Chlorides · Sulphuric Acid · Superphosphate* · Tartar Emetic · Tartaric Acid · Titanium Tetrachloride · Titanium Trichloride Solution · "Zol" Dry Cleaning Fluid **

*(*West Coast Only)*

Stauffer Chemical Company — Since 1885

STAUFFER CHEMICAL COMPANY

380 Madison Avenue, New York 17, N. Y.

221 N. La Salle Street, Chicago 1, Ill. • 326 So. Main Street, Akron 8, Ohio • 824 Wilshire Boulevard, Los Angeles 14, Calif. • 636 California Street, San Francisco 8, Calif. • North Portland, Oregon • P. O. Box 7222, Houston 8, Texas • Weslaco, Texas • Apopka, Florida

Panalarm Products Advances Hudson to Vice President

Howard W. Hudson has been appointed vice president of Panalarm Products, Inc., Chicago. In this new position, he will be in charge of the company's engineering and production activities.

Hudson

Prior to 1950, Hudson was associated with the management consultant firm of Griffenhagen & Associates. He then formed his own company and served Panalarm and its parent organization, Panellit, Inc., and another subsidiary, Panascan, Inc., in the capacity of management consultant. He came to Panellit, Inc., and its subsidiaries on a full-time basis in 1952.

Hammel-Dahl Company Moves David Golner to Sales Manager

The Hammel-Dahl Company, Providence, R. I., has announced the promotion of David Golner to sales manager.

Golner

Since joining Hammel-Dahl Company in 1945 as a development engineer, Golner has been closely affiliated with all phases of manufacturing, sales and management.

Prior to joining Hammel-Dahl he was associated with Curtiss-Wright Aircraft Corporation. He is a graduate of Brown University.

Three Receive Promotions In U. S. Steel's Oil Well Supply

The Oil Well Supply Division of United States Steel Corporation has promoted J. D. O'Brien to manager of its area sales office at Fort Worth, succeeding Byron Post, who is retiring. O'Brien has been city representative at Fort Worth since 1947.

Ralph Crowe, manager of "Oilwell's" branch store at Wichita Falls, Texas, has been named to fill O'Brien's former post. Crowe joined "Oilwell" at Anson, Texas.

The present manager of "Oilwell's" branch store at Anson, E. E. Rust, has been named to succeed Crowe as manager of the Wichita Falls store.

Union Carbide Groups Units In Canada Under Subsidiary

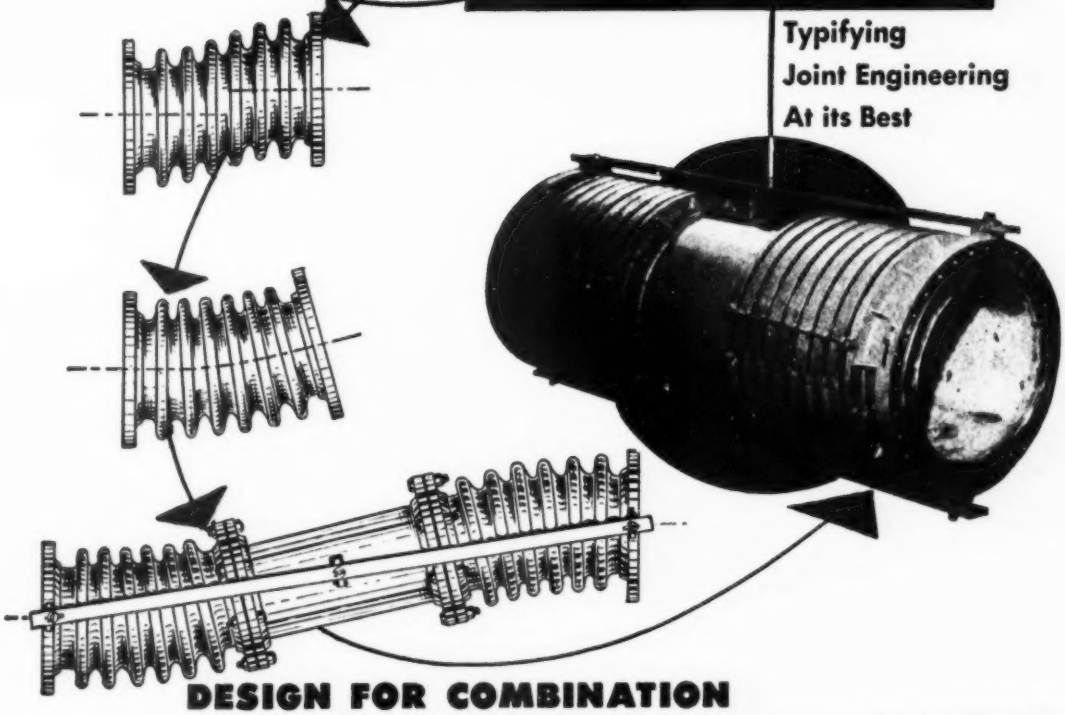
Union Carbide Canada, Ltd., a subsidiary of Union Carbide and Carbon Corporation, has begun operating the business of all of the following companies: Bakelite Company (Canada), Ltd., Canadian Railroad Service Company, Ltd., Carbide and Carbon Chemicals, Ltd., Dominion Oxygen Company, Ltd., Electro Metallurgical Company of Canada, Ltd., and National Carbon Ltd.

These Companies are units of Union Carbide and Carbon Corporation. In the future their respective businesses will

Badger

EXPANSION JOINTS

Typifying Joint Engineering At its Best



DESIGN FOR COMBINATION LINEAR-SHEAR-LATERAL MOVEMENTS

Study these sketches showing (somewhat exaggerated, of course) several of the more complex movements to which expansion joints are often subjected. Do you have such pipe line conditions? Do you have any installation coming up that might involve such movements?

Here's the Badger Joint that is designed for just such a problem: the TANDEM JOINT. It's available in both Self-Equalizing and Non-Equalizing design. The joint movement is controlled by the tandem bars pivoting on a pin in the connecting nipple. Permissible shear or lateral movement depends upon the overall length as well as the number of corrugations in each unit. Each tandem unit is designed to suit the individual job requirements.

The Tandem Joint is but one of several special types designed for complex pipe line movements. We'll be glad to study your problem and make recommendations. Should yours be a straight linear traverse—as most installations are—we have a wide range in Directed Flexing, Self-Equalizing and Non-Equalizing Joints made of copper or stainless steel, with flanged or welding ends.

Badger Expansion Joints come in a variety of types and a wide range of sizes: Directed Flexing, Self-Equalizing for longer traverses and higher pressure; Non-Equalizing, for shorter traverse or when pressures are low. Tandem Joints for combination axial and lateral movements; Clevis Joints for angular rotation.

Special Vibration Control Joints; Flexible Pipe Line Seals for watertight connection between pipe and flood walls.

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE 41, MASS.

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Suppliers . . .

be carried on by divisions of Union Carbide Canada, Ltd., under the following division names: Bakelite Company, Canadian Railroad Service Company, Carbide Chemicals Sales Company, Dominion Oxygen Company, Electro Metallurgical Company, and National Carbon Company.

Davison Names Treasurer

J. Sinclair Marks, assistant treasurer of The Davison Chemical Corporation, has been elected treasurer, to succeed J. Early Hardesty, resigned. Raymond S. Clark, counsel of the company, at the same time was elected assistant secretary.

New Purchasing Department Established by Cyanamid

American Cyanamid Company has announced the creation of the Industrial Chemicals division, Purchasing department and the appointment of Robert C. Brown as division purchasing agent.

Brown had been purchasing agent for Jefferson Chemical Company, Inc., a firm owned jointly by Cyanamid and The Texas Company.

Witco Expands Chicago Plant

Witco Chemical Company is enlarging its drier plant in Chicago with the addition of a new operating wing. When completed, the new installation and the present equipment will be integrated into one operation.

Gill Heads New Assignments At Vapor Recovery Systems

Vapor Recovery Systems Company has made three new assignments to its New York office staff.

Barry

Gill

Frank B. Gill, who has had wide experience in the electrical, chemical and processing industries, has taken charge of the office as New York district sales manager.

Norman E. Barry, formerly a sales engineer with Minneapolis - Honeywell Regulator Company, has become a sales engineer.

Warehime

Norwood R. Warehime, associated with U. S. Testing Company prior to joining "Varec," has also become a sales engineer.

B&W Division Has Design Of Research Atomic Reactor

A detailed design of a research atomic reactor has been prepared by the Atomic Energy division of The Babcock & Wilcox Company, according to J. W. Landis, of the division. Landis said his company is willing to submit firm bids on both the manufacture and installation of the reactor at any spot in the U. S.

Landis explained that the reactor was designed by his company primarily for colleges and other organizations engaged in atomic research but that it could also be used, with government approval, to produce radioactive isotopes for industrial and medical uses.

Another Babcock & Wilcox official, C. H. Gay, vice president in charge of the Atomic Energy division, said the reactor for a purposed atomic powered locomotive is already on the division's designing boards. He said the reactor employs fluid rather than solid fuel. He feels that such a reactor will find other uses besides that proposed for it in the locomotive.

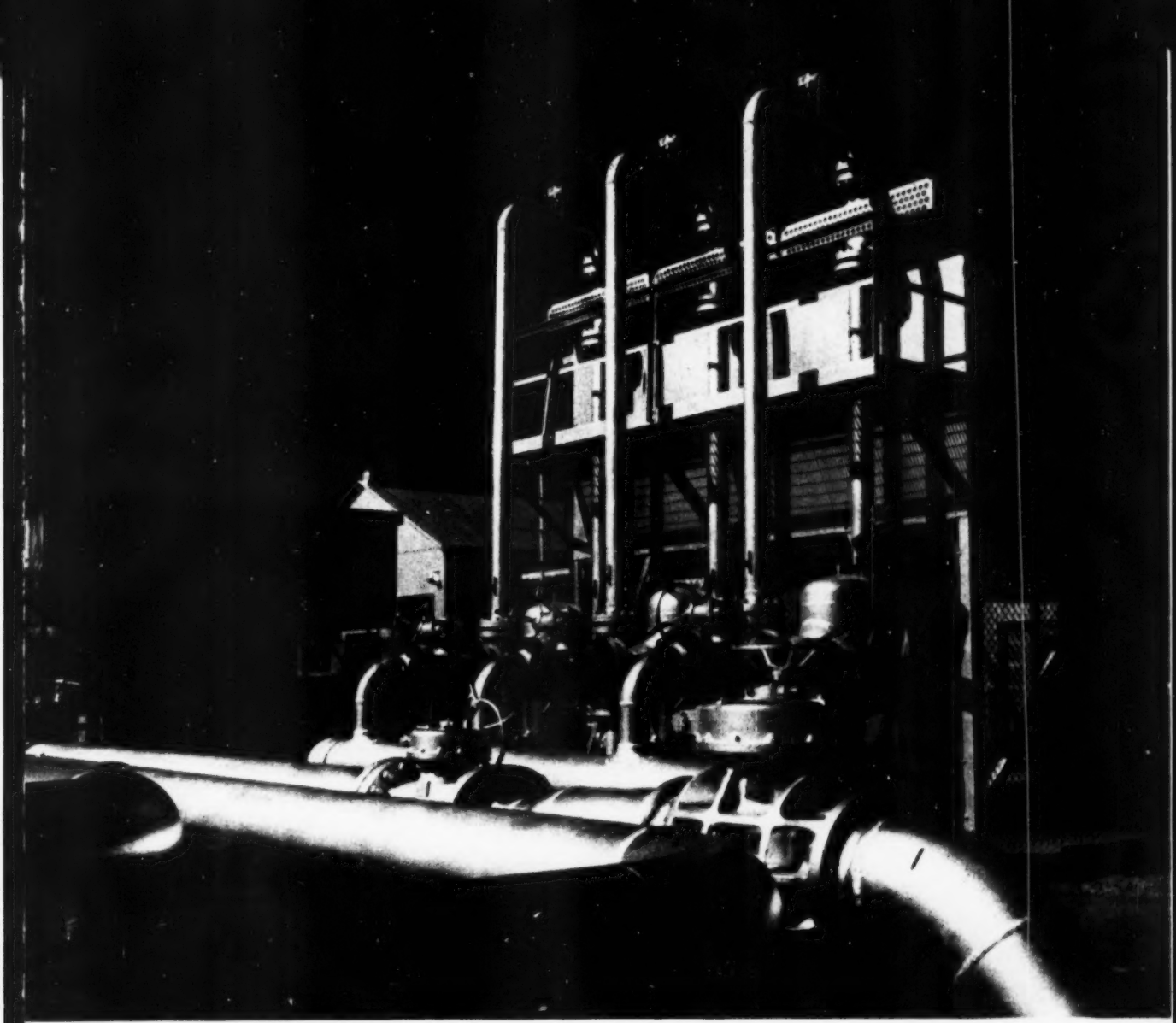
Worthington Completes Large Hydraulic Test Laboratories

One of the world's largest, most complete and flexible hydraulic test laboratories of its kind has been completed and placed in operation at the Harrison works of Worthington Corporation. The laboratory covers over 20,000 square feet at the 43-acre Harrison plant and has been over three years in the planning and building.

Designed basically for production or performance testing, the huge "hydraulic proving ground" will also be used for

Refiners! Triangle Brand Copper Sulphate is the right reagent for your oil sweetening process. Triangle Brand Copper Sulphate is available in grades for use in dry form when oil must be partly desulphurized, or for aqueous solutions to remove mercaptans, other sulphur compounds, malodorous and resinous substances from cracked distillates. Use Triangle, it's 99% + pure.

PHELPS DODGE REFINING CORPORATION
40 Wall Street, New York 5, N.Y.
230 North Michigan Avenue, Chicago 1, Illinois



CONSTANT CONTROL FOR CONTINUOUS PROCESSES

Ever notice how many Rockwell-Nordstrom valves you see at key points in continuous operation processes—where failure of one valve can shut down an entire plant? There's a sound reason for that: Nordstrom valves have a reputation for *not* failing.

If it's wise to use Nordstrom valves in *tough* spots—in lines that must operate 24 hours a day, 365 days a year, year in, year out—doesn't it stand to reason they'll give better service in almost *any* spot?

Nordstrom's first costs are comparable to other valves. In the long run, they're invariably the best buy. There's no substitute for Rockwell experience. Use it to save money on valves. *Rockwell Manufacturing Company, Pittsburgh 8, Pa.*

THREE WAYS
THE NORDSTROM LUBRICANT WORKS

Lubricant surrounds each valve port with a vapor tight pressurized seal. **Nordstrom valves stay tight.**

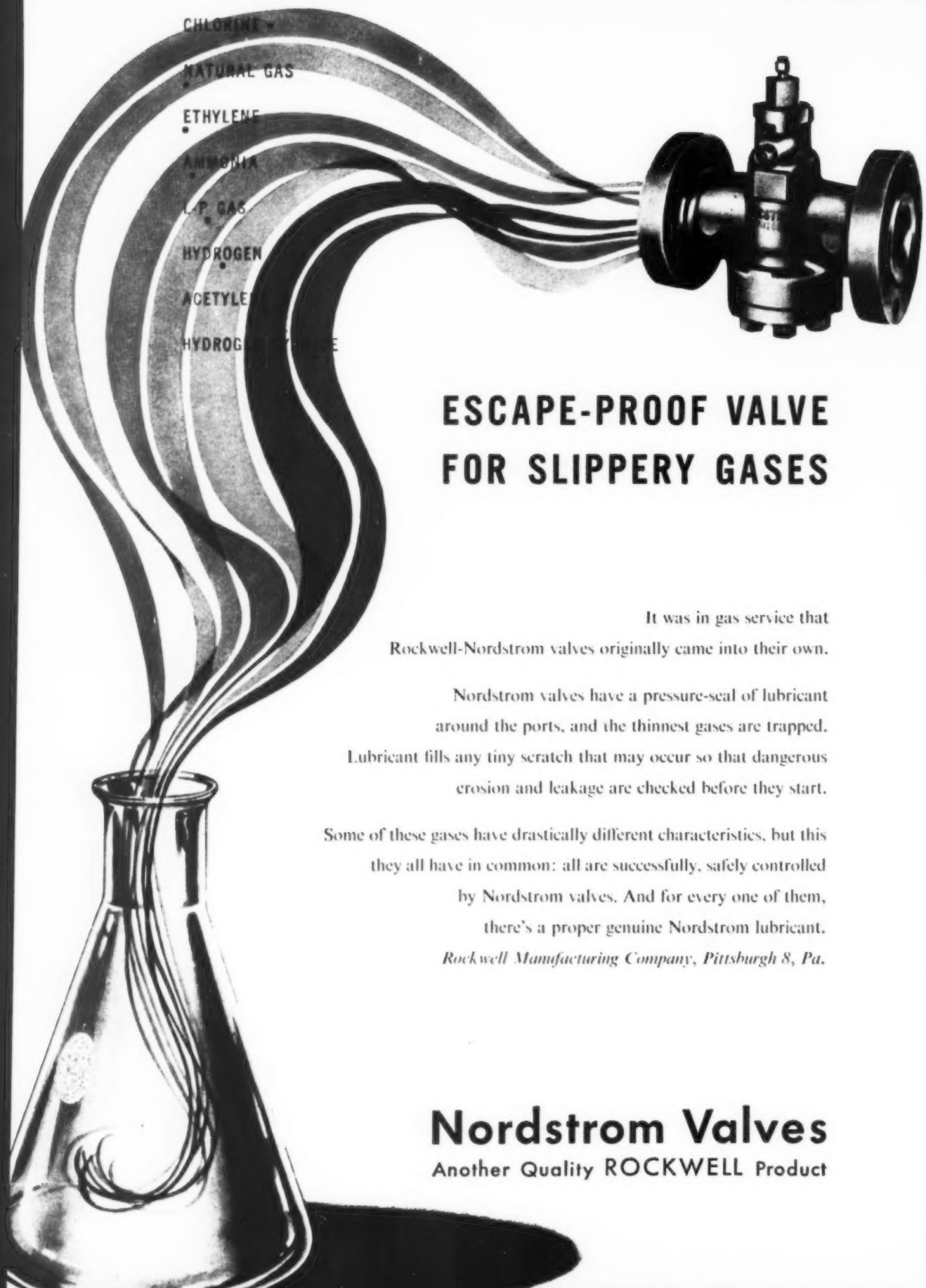
Lubricant acts as hydraulic jack—a fast quarter-turn to open or close. **Nordstrom valves operate quickly.**

Lubricant coats the plug for sliding action—no wear producing wedging. **Nordstrom valves operate easily.**

Rockwell Built

NORDSTROM VALVES

Lubricant Sealed for Positive Shut Off



ESCAPE-PROOF VALVE FOR SLIPPERY GASES

It was in gas service that Rockwell-Nordstrom valves originally came into their own.

Nordstrom valves have a pressure-seal of lubricant around the ports, and the thinnest gases are trapped. Lubricant fills any tiny scratch that may occur so that dangerous erosion and leakage are checked before they start.

Some of these gases have drastically different characteristics, but this they all have in common: all are successfully, safely controlled by Nordstrom valves. And for every one of them, there's a proper genuine Nordstrom lubricant.

Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Nordstrom Valves

Another Quality ROCKWELL Product

applied research and development of fluid handling machinery.

Roots-Connersville Hits 100—

On the occasion of Roots-Connersville Blower's one hundredth birthday anniversary, Indiana Governor Craig, right, congratulates Ralph R. Newquist, president of the company. Standing at left is R. E. Reimer, vice president of Dresser Industries, Inc., of which Roots-Connersville is a division.

Roots-Connersville Blower Has One Hundredth Birthday

Awarding of special anniversary service pins and a talk by Indiana Governor Craig highlighted Roots-Connersville Blower's recent celebration of its one hundredth birthday. Nearly 1000 employes and their families filled the Connersville High School Auditorium to hear the governor and witness the awarding of service pins to 600 employes.

A 50-year service pin went to Albert E. Loyd, New York, who was present at Connersville, Ind., for the program. Jesse W. Woodall received a 45-year pin. Roots-Connersville is a division of Dresser Industries, Inc.

Petrofluid Conditioning Will Be Headed by Payte, Patrick

D. F. Payte, general manager of Empire Machinery Company of Dallas, has been named general manager of the newly formed Petrofluid Conditioning Company, also with headquarters in Dallas.

Payte

The new company headed by Payte will be devoted exclusively to the distribution of Evis oil and water conditioners to petroleum producers and refiners throughout the Southwest, with the exception of West Texas, which will continue to be serviced by Empire Machinery Company.

Payte has been active in sale and service of oil field equipment since 1927. Associated with Payte in the new company is Thad Patrick, who will serve as chief engineer. Patrick was formerly affiliated with the State of Texas Health Department in Austin.

Abbey Will Supervise Sales In Latin America for MSA

Arch S. Abbey has been appointed manager of the Latin American section, International division, of Mine Safety Appliances Company, Pittsburgh. He will supervise MSA's sales of mining and industrial safety equipment in that area. Abbey has been associated with Mine Safety Appliances since 1935.

De Laval Adds Representatives

Two exclusive representatives in Central America have been appointed by De Laval Steam Turbine Company. In El Salvador, De Laval products will be handled by La Casa Castro of San Salvador. In Costa Rica, the company will be represented by Francisco Font of San Jose.

Suppliers . . .

National Cylinder Gas Makes Corporate Structure Changes

Two of four wholly owned subsidiaries of National Cylinder Gas Company are now operating as divisions, and the corporate charters of the remaining two have been surrendered and their operations taken over by the parent company.

Tube Turns, Inc. with headquarters in Louisville, Ky., has become the Tube Turns division. Pennsylvania Forge Corporation, Philadelphia, has become a division known as Pennsylvania Forge Company. Hollup Corporation, Chicago, and National Cylinder Gas Company—

Florex—for adsorption

Recognized throughout the world as superior to all other natural clays used in adsorption processes, Florex is particularly effective in the adsorptive refining, decolorization, clarification and neutralization of mineral, vegetable, and animal oils, fats and waxes. Florex is also effectively used for sweetening light distillates, dehydration, desulfurization and polymerization.

Florex is prepared from carefully selected natural Florida Fullers Earth by a special processing including high-pressure extrusion, which greatly improves adsorptive efficiency and capacity.

Standard particle sizes are herein reproduced and include meshes from 2/4 to 200/ up. Special meshes are also available. Florex is packaged to fulfill customer's requirements with the Fifty (50) pound non-returnable paper bag the minimum quantity.

For further information use free request coupon below.

FLOREX MESH—ACTUAL SIZE

100-UP
60/100
30/60
16/30
8/16
4/8
2/4

FLORIDIN COMPANY

● Adsorbents
● Desiccants
● Diluents

DEPT. E, 220 LIBERTY STREET
WARREN, PA.

Please send literature ☐ and sample ☐ of Florex
(Be sure to indicate mesh size_____)

Name_____

Address_____

City_____

For more data on advertised products, use Readers' Service Cards, last page.

Hose Replacement Reduced 1/3

with

Quaker

IRONSIDES STEAM HOSE

How to lessen hose replacement yet maintain production? That was the cost problem faced by a large chemical company—and solved by Ironsides' ability to give three times the service of other makes. Widely accepted as the strongest, safest hose for general steam service, Ironsides is braided with steel wire and bonded with rubber. Added braid of glass cord for insulation and extra strength. Kink-proof. Easy to handle. At least 4 times stronger than wrapped fabric hose yet costs no more. For economy, use Ironsides a Quaker exclusive for greater service and safety.

Write for free folder and name of nearest distributor.

Belting, Hose, Packing and Moulded Rubber of every construction for every need.

QUAKER RUBBER CORPORATION
DIVISION OF H. K. PORTER COMPANY, INC.
OF PITTSBURGH
PHILADELPHIA 24, PA.
Branches in Principal Cities

Suppliers . . .

Pacific Coast, have been dissolved.

There will be no changes in the organization or method of operation of either Tube Turns or Pennsylvania Forge Company. All officers of the two former corporations have been reelected to the same offices in the new companies.

R. E. McBurnette Joins Norris Tulsa Sales Staff

W. C. Norris, Manufacturer, Inc., has announced the addition of R. E. (Mac) McBurnette to its staff as a salesman in Tulsa.

McBurnette

For the past four years the new appointee has represented Axelson Manufacturing Company in Kansas, with headquarters at Great Bend.

McBurnette attended Oklahoma A. & M. College, Stillwater, and majored in marketing. During World War II he served five years in the U. S. Air Corps, including 39 months in the Pacific area.

Elliott Division Elevates Hostetter to General Manager

S. K. Hostetter, Jr., sales manager of Elliott Company's Crocker-Wheeler division for the past year, has been named general manager of the division.

Hostetter

Hostetter joined Elliott Company in 1934 after his graduation from Pennsylvania State University. Before going to the Crocker-Wheeler division he had been in the company's Washington office. At Washington he had been first a field engineer and then a district manager for ten years.

Neal LauBach Elected Head Of Cooling Tower Institute

Neal B. LauBach of Hudson Engineering Corporation, Houston, has been elected president of the Cooling Tower Institute.

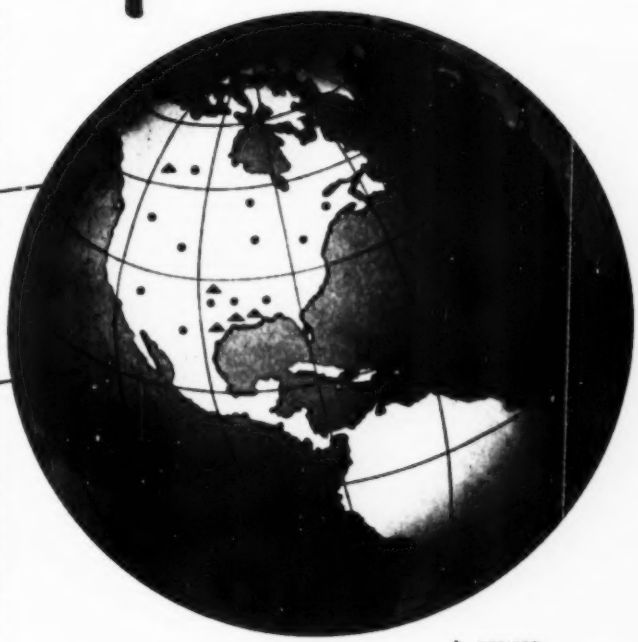
Other new officers are: Paul R. Hoffmann, Lilie-Hoffmann Cooling Towers, Inc., vice president; Clayton E. Pickup, The Fluor Corporation, Ltd., secretary; and Robert R. Pabodie, United Cooling Tower Company, treasurer. President for the 1953 term was Leon T. Mart of The Marley Company.

American Locomotive Names Engineering General Manager

Appointment of Martin Ettington as general manager of engineering has been announced by American Locomotive Company. Ettington will be in charge of all

Insulation Specialists..

- CONTRACTING
- SPECIFICATION
- ENGINEERING
- MAINTENANCE



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● INSTALLATIONS

WHEREVER YOU BUILD . . . . . Edmonton to Puerto Rico

WHATEVER THE SIZE . . . . . Compressor Station or Polyethylene Plant

TEMPERATURE . . . . . —200° F. to +1800° F.

MANPOWER . . . . . 2,621 Employed in '53

FINANCE . . . . . $3 Million Bond Credit

EXPERIENCE . . . . . 2,078 Projects Completed

TYPE PLANT . . . . . Chemical, Petroleum, Cold Storage, Power, Paper, Atomic Energy

MATERIALS . . . . . Distributor: UNIBESTOS, FOAMGLAS

IT'S THE ABER COMPANY* . . . . . .

THE ABER COMPANY, INC.

4832 ALMEDA RD. • P. O. BOX 2535 • HOUSTON, TEXAS

BRANCHES: TULSA • SHREVEPORT • BATON ROUGE

*In Canada: The Aber Company of Canada, Ltd., Edmonton, Alberta, Canada.

For more data on advertised products, use Readers' Service Cards, last page

Typical Van-Cor pipes and fittings fabricated to specifications by Van Dorn

Van-Cor

INDUSTRIAL PLASTICS—

✓Both *Chemically Resistant* and *Impact Resistant* Types

✓Tensile Strength of Aluminum, with one-half its weight

✓Readily Formed, Machined, Drawn Molded or Welded

AVAILABLE FORMS

SHEETS . . . .⅛" through 1"
PIPE . . . . .½" through 6" diameter (10 ft. lengths)
ROUND BARS .¼" through 2" diameter (10 ft. lengths)
WELDING ROD .⅛" and ¼" diameter

TYPICAL APPLICATIONS

Van Dorn fabricates its Van-Cor rigid non-plasticized polyvinyl chloride into such products as: Ducts, Hoods, Chemical Tanks, Tank Liners, Plating Racks, Fume Stacks and Piping.

WRITE FOR ILLUSTRATED BULLETIN AND SPECIFICATIONS

INDUSTRIAL DIVISION OF
COLONIAL PLASTICS MFG. CO.

SUBSIDIARY OF
THE VAN DORN IRON WORKS CO.
2685 East 79th Street • Cleveland 4, Ohio

How to strip a storage tank

without scraping or sandblasting

BUT FAST—that's how old coats of paint roll off when you strip tanks the quick, money-saving Oakite way.

Powerful Oakite strippers, applied by hot-flow-on, steam-gun, or cold-flow-on method, actually float off paint, dirt, and grease—right down to the base metal. You save time . . . no hand scraping, chipping or blasting. You save money . . . long-life solution may be reclaimed and reused. And you're safe . . . no fire hazard.

Ask your local Oakite Technical Service Representative for on-the-spot demonstration. Or write Oakite Products, Inc., 50B Rector St., New York 6, N. Y., for details.

FREE Booklet F7629—full of information on maintenance cleaning in all divisions of the Petroleum Industry—describes proved, money-saving Oakite procedures for such jobs as

- cleaning stabilizing towers
- cleaning tank car interiors
- descaling heat exchangers in place
- reconditioning barrels
- salvaging rigs, valves, fittings

Copy sent on request. Write today!

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE
PETROLEUM SERVICE DIVISION

Suppliers . . .

product engineering activities at each of Alco's six plants. He will establish headquarters at Schenectady, N. Y.

Ettington joined the Alco Products division of American Locomotive and has been an Alco Products director since 1953.

Watson-Stillman Fittings Names Tough Sales Manager

Appointment of J. M. Tough as sales manager, Watson-Stillman Fittings division, H. K. Porter Company, Inc., Roselle, N. J., has been announced.

Tough

Tough, who has been with Watson-Stillman since 1942, will be responsible for the company's entire sales activities. He came to the company as a sales representative and later was made district manager of the Chicago territory. He continued in that capacity until his present appointment.

Previous to his coming to Watson-Stillman, Tough served as branch manager, New York territory, for Ahlberg Bearing Company.

Hammond Adds Walker As Southeastern Sales Manager

Max G. Walker has been appointed sales manager for the southeastern part of the U. S. for Hammond Iron Works.

Walker

Walker is well known in the construction and petrochemical industries. He was for over six years Chicago district sales manager for Murphy Diesel Company, Milwaukee. He was also identified with construction activities in petroleum and mining industries in South America. Walker will make his headquarters at the new Hammond Iron Works plant at Birmingham, Ala.

New Fischer & Porter Division To Develop Special Instruments

In the latest step in its expansion program Fischer & Porter Company, Hatboro, Pa., has created a Special Products division for the development of special instruments and instrument components to contract specifications. Edward H. Muhleisen, who has served as both field engineer and applications engineer for the company, has been appointed manager of the new division.

Houdry Handling Applications Of Catalytic Oxidation Units

Refinery applications of the catalytic oxidation units manufactured by Oxy-Catalyst, Inc., of Wayne, Pa., have been taken over by Houdry Process Corporation. Houdry is promoting the use of this catalyst in the petroleum industry

ALLOY STEEL BOLT STUDS

CENTERLESS GROUND

to Provide Smoothest Finish

At No Extra Cost . . .

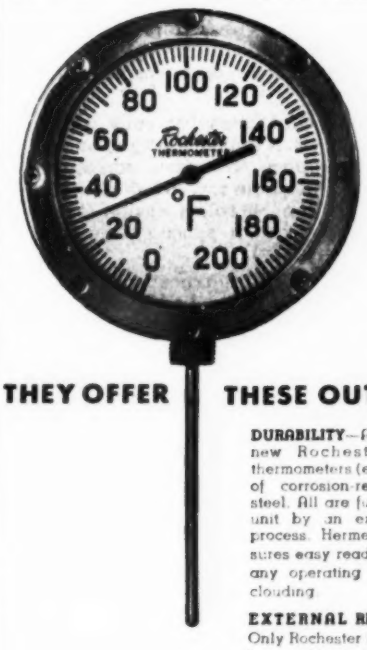
- Made from heat-treated bars—(A.S.T.M. A193 Grade B-7).
- Threads *centerless-ground* to provide smooth finish unobtainable with most other production methods.
- Finish of KILBOURN ground threads greatly reduces seizing during assembly or disassembly.
- Widely used by oil refineries, chemical plants, power plants, pipe-line installations.

Write for Bulletin

KILBOURN® *Engineering* Company, Inc.

5102 N. 35th St., Milwaukee 9, Wis.

STUDS • THREADED BARS • STILL SCREWS • STAINLESS STUDS AND NUTS



Here's something

NEW

in

straight-form thermometers

THEY OFFER THESE OUTSTANDING PLUS FEATURES:

DURABILITY—All parts of the new Rochester straight-form thermometers (except crystal) are of corrosion-resistant stainless steel. All are fused into a single unit by an exclusive welding process. Hermetic sealing assures easy reading of dial under any operating condition. No clouding.

EXTERNAL RECALIBRATION—Only Rochester thermometers can be recalibrated externally. A screw adjustment permits you to restore accuracy even if you knock the thermometer out of adjustment with a hard blow.

SELECT YOUR STEM POSITION—This thermometer is ordinarily supplied with the stem located at the bottom. However, it can be placed at the location you desire around the entire dial circumference. Available in stem lengths from 2½ to 48 in. Send for further information today. Write: Rochester Manufacturing Company, Inc., 38 Rockwood Street, Rochester 10, N. Y.

Rochester Manufacturing Company, Inc.
38 Rockwood St., Rochester 10, N. Y.

ROCHESTER DIAMOND INDUSTRY GAUGES

DIAL THERMOMETERS GAUGES AMMETERS

For more data on advertised products, use Readers' Service Cards, last page.

Page Welding Wire

Now—a new line-up of PAGE welding wire in coils, reels, packages

• Here are some of the ways PAGE welding wires are packaged to protect them during shipment and to make it easy for you to handle and stock them. Two new packages are Leverpaks and pallet-mounted coils.

LEVERPAKS • Here's one of the best containers for coils up to 16" ID. It's light-weight, but durable. It is sealed air-tight and is packed with moisture-absorbing substance to reduce corrosion. Release safety catch, pull lever, and the whole top comes off. It's just as quickly resealed. Leverpaks can be rolled easily. They stack perfectly and take a minimum of floor space. They cost you nothing extra and have many re-uses.

PALLET-MOUNTED COILS • If you have a fork-lift truck, you'll like PAGE's new pallet-mounting of 22" ID coils. Steel strapping and paper wrapping protect coils and hold them securely. You can run them in and out of freight cars and trucks, and spot them in your plant.

AUTOMATIC WELDING WIRES • **Inert Gas**—Six PAGE-ALLEGHENY stainless grades in .035", .045", and .0625" diameters. Precision thread-wound on 25-lb. non-returnable reels to fit popular arc welding machines. **Submerged Arc**—PAGE Stainless in wire diameters from 1/32" to 5/16", plain or copper coated. In layer-wound coils or 22" or 24" mill coils.

GAS WELDING RODS • In a variety of analyses: stainless, Armco, medium and high carbon, and manganese or naval bronze.

Warehouse stocks in Chicago, Denver, Houston, Los Angeles, San Francisco

Write our Monessen, Pa., office for literature and prices

ACCO

Page Steel and Wire Division
AMERICAN CHAIN & CABLE

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, San Francisco, Bridgeport, Conn.

Suppliers . . .

for the recovery of heat from waste cracking gases, and the abatement of smog and other nuisances resulting from refinery fumes. The oxidation catalyst so far has been used to improve oxidation efficiency and minimize air pollution in industrial applications varying from metal coating to fish curing.

Peterson and Wilson Get New Honeywell Assignments

Appointments of C. L. Peterson as divisional vice president of the Brown

Peterson Wilson

Instruments division of Minneapolis-Honeywell Regulator Company and O. B. Wilson as general sales manager were recently announced.

Peterson, who had been general sales manager of the division since July, 1952, will devote the major part of his time to sales policy matters and long-range planning. In addition, he will assist in carrying out managerial duties at the policy-making level. Wilson, industrial instruments sales manager since January, 1953, will assume active administration of the entire divisional Sales department.

FitzRoy Becomes Manager Of Metal Goods Products Division

Metal Goods Corporation has announced the appointment of Donald A. FitzRoy to manager of its Industrial Products division.

FitzRoy

FitzRoy, who was formerly assistant manager of the Industrial Products division, joined Metal Goods Corporation in 1949 as a general line salesman. Previously, he was associated with the Air Reduction Company for a number of years. In his new assignment, he will handle fastenings, fittings, valves, brazing alloys, castings, and many other industrial metal accessories.

Dow Corning Subsidiary Opens New Canadian Office

Dow Corning Silicones, Ltd., new Canadian subsidiary of Dow Corning Corporation, has moved into a new office and warehouse building in Toronto and is now doing business. The Canadian company's new home contains 2000 square feet of office space and 100,000 square feet of warehouse area. D. C. R.

THIS TOPS EVERYTHING!

Cooling tower construction superintendents who wear this hat assure you substantial savings every time you choose a Pritchard cooling tower. For under this hat is all the collective skill and know-how developed in 89 years of in-the-field experience with Pritchard erection teams. This exceptional background of Pritchard construction men means that you get great savings in time and money *plus* a guarantee that your cooling tower will be built right... will do the efficient job it was designed to do for a long, long time.

Industry's Partner for Progress

COOLING TOWERS
SPECIALIZED HEAT EXCHANGERS
GAS & AIR TREATING EQUIPMENT

J. F. Pritchard Co.
OF CALIFORNIA
A DIVISION OF J F PRITCHARD & CO.
Dept. 379, 210 West 10th Street, Kansas City 5, Mo.

Representatives in Principal Cities from Coast to Coast

For more data on advertised products, use Readers' Service Cards, last page

install peak performance into your compressors (AIR • GAS • AMMONIA)

Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

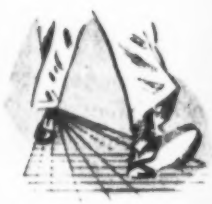
Check THESE VOSS VALVE ADVANTAGES:

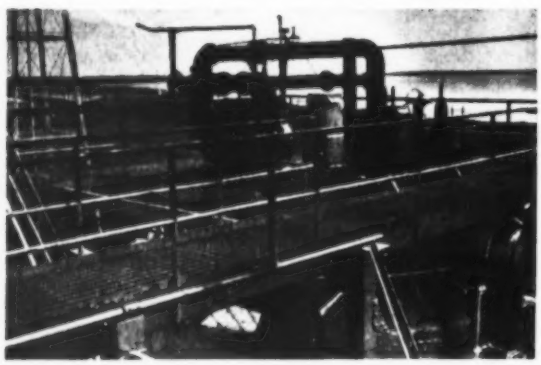
- Quiet, vibration-free operation
- 20 to 60% more valve area
- less power consumption
- minimum pressure loss
- normal discharge temperature
- lower operating costs
- utmost safety

Our detailed proposal for increasing the efficiency of your compressor will be sent you without obligation. Send us the name, bore, stroke, and speed of your machine.

VOSS VALVES / J. H. H. VOSS Co. Inc. 784 East 144th Street New York 54, N. Y.

WHERE SURE FOOTEDNESS COUNTS





Gary

STEEL GRATING MAKES WALKS SAFER

Sturdy, one-piece construction with tops of all bars flush provides open steel flooring and stairs for safe, easier walking. Gary Grating is furnished in a wide variety of neat appearing designs and sizes—and is tailor-made to fit your needs. For complete description and installation pictures on Gary Welded Grating, Stair Treads and Gary-Irving Decking, ask for Catalog PF-44.

FREE SAMPLE
We'll send this handy paper weight if you request it on your company stationery.

Standard Steel Spring Division
ROCKWELL SPRING AND AXLE CO.
4011 East Seventh Avenue • Gary, Indiana

Suppliers . . .

Miller, an experienced product development engineer well known to Canadian industry, has been named general manager of the new company.

G. C. Bayles Will Manage New Elliott Sales Office

Humphrey Bayles

Elliott Company has opened a new sales office in New Orleans, La., to service southern Mississippi and Louisiana. Its staff includes G. C. Bayles, as manager, and C. W. Britt, Jr., both formerly in the company's Atlanta, Ga., office. Bayles was formerly a field engineer in the Atlanta district office.

In Elliott's Atlanta territory, F. L. Humphrey, Jr., has been named assistant district manager. He has been in the Atlanta office since 1946.

Robers Becomes Sales Manager Of New Weatherhead Division

Gene P. Robers has been named sales manager of the new Distributor division of The Weatherhead Company. He will direct selling of Weatherhead's automotive replacement parts and other company products.

Robers

Since joining Weatherhead 12 years ago, Robers has served as assistant advertising manager and director of all advertising and promotion work. In 1946 he was made sales manager of the Standard Parts division, a position he held at the time of his recent appointment.

Chicago Bridge & Iron Makes Changes in Sales Department

In changes in the Sales department of Chicago Bridge & Iron Company:

Quinton Thomas, formerly in the company's Birmingham, Ala., office, has been transferred to the Tulsa sales office; and Grover Campbell, formerly in the company's Chicago general sales office, has been transferred to the Atlanta sales office.

Porter to Acquire McLain

H. K. Porter Company, Inc., Pittsburgh, plans to acquire the business of The McLain Fire Brick Company. The McLain Company, founded in 1903, operates six plants in Pennsylvania and Ohio. Operations will continue as The McLain Fire Brick Company, division of H. K.

PROCESS EQUIPMENT AND PRESSURE VESSELS

Oil Country Boiler Installation

5—150 H.P., 500 Lbs. W.P. Boilers

1. ALL-WELDED—for long life and low maintenance expense
2. FIREBOX SIDES SLANTED—for quick and efficient steaming
3. WATERLEGS TAPERED—for fast circulation with high heat transfer
4. LARGE WATER VOLUME—for smooth operation with steady pressure

Streamline Welded

F & T Products

Absorption Towers	Autoclaves
Alloy Steel Equipment	Bubble Towers
Butane Storage Tanks	Catalyst Towers
Fractionating Columns	Heat Exchangers
Heating Boilers	Jacketed Vessels
Oil Country Boilers	Power Boilers
Recirculating Furnaces	Tanks

Waste Heat Boilers

FARRAR & TREFTS INC.

Established 1863

Buffalo 12, New York

FAST SERVICE for a DELAYED COKING UNIT

Everyone knows there's nothing slow about a delayed coking unit. Time is one of the most important factors in the oil industry . . . but in order to save time . . . it takes experience. Dollinger's has the experience. The delayed coking unit shown in the photograph was designed and erected by The M. W. KELLOGG COMPANY for GENERAL PETROLEUM COMPANY of Torrance, California. Over three hundred tons of steel by Dollinger was supplied for this job.

FOR OVER 50 YEARS, LEADERS IN THE OIL INDUSTRY HAVE LOOKED TO JOHN DOLLINGER, JR., INC. FOR QUALITY STEEL FABRICATION AND DEPENDABLE DELIVERY.

ST DOLLINGER AROUND THE WORLD

For inquiries regarding fabricated structural steel and plate steel, write to John Dollinger, Jr., Inc. Beaumont, Texas

HIGHEST PURITY

TWO OUTSTANDING GRADES OF—

SUBLIMED ANHYDROUS ALUMINUM CHLORIDE

THE PUREST COMMERCIAL MATERIAL AVAILABLE

— *SPECIFICATIONS* —

1. RESUBLIMED GRADE:
   COLOR: White to very Lt. Yellow
   SUBLIMINATION: Min. 99% gran. or lump
   Min. 98.5% powder
   WATER INSOLUBLE: None
   HEAVY METALS: None
   IRON CONTENT: Max. 0.01%
2. TECHNICAL GRADE (SUBLIMED):
   COLORS: Lt. Yellow to Gray
   SUBLIMINATION: Min. 98% gran. or lump
   Min. 97.5% powder
   WATER INSOLUBLE: Max. 1.0%
   HEAVY METALS: Trace
   IRON CONTENT: Max. 0.05%

Both Grades May Be Had In Standard Or Special Particle Sizes

WRITE FOR OUR COMPLETE TECHNICAL CATALOG.

OHIO APEX for

OHIO-APEX DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

NITRO, WEST VIRGINIA

For more data on advertised products, use Readers' Service Cards, last page.

Standardaire Blowers
Standardaire Blowers are designed to give dependable, trouble-free performance on a wide variety of refinery jobs. Compactly designed, the Standardaire Blower is an axial flow, positive pressure unit for handling gas or air under pressure or vacuum. Employing an exclusive principle of compressing air on a modified adiabatic cycle with lower mean internal pressure, the Standardaire Blower permits the greatest output per pound of weight ever achieved in this type of blower. With its wide range of pressures, it is essentially a high-speed unit which permits direct drive by standard motors. Through symmetrical generated rotors producing an air screw effect, air is taken in and discharged smoothly from pockets which form between the rotors, resulting in compression that is gradual and free from shock.
READ STANDARD
CORPORATION
BLOWER-STOKER DIVISION
370 Lexington Avenue
New York 17, New York
Read Standard also manufactures a complete line of chemical mixers for laboratory and industrial use. Write to
READ STANDARD CORP., YORK, PA.

Suppliers . . .

Porter Company, Inc., under the direction of W. A. Turner, vice president and general manager.

Ethyl Announces Promotion Of Four to Manufacturing Posts

Promotion of Wallace F. Armstrong from manager of the Houston plant to assistant general manager of manufacturing, a new position, has been announced by Ethyl Corporation.

Armstrong

Other promotions to management positions in Ethyl's Manufacturing department: Glenn O. Hayes, from acting assistant manager at the Baton Rouge, La., plant to manager of the Houston plant; Melvin C. Hudgins, from acting manager of maintenance to assistant manager of the Baton Rouge plant; and James J. Bergin, from superintendent of operations to assistant manager of the Houston plant. The appointments of Hudgins and Bergin are to new positions.

Roy N. Clothier, who has been manager of the Baton Route plant since 1951, continues in this position.

Rockwell Manufacturing Adds Mankin to Engineering Staff

Paul A. Mankin has been named chief engineer of the Pittsburgh Equitable Meter division of Rockwell Manufacturing Company.

Mankin

Mankin, a former vice president of Bowser, Inc., will assume charge of Rockwell's petroleum and industrial meter development program and will also direct the engineering of the Drill Unit division. His headquarters will be at the Homewood, Ill., plant.

Mankin began his professional career as a sales engineer for Sears-Roebuck and Company.

Hercules Advances Two In Explosives Department

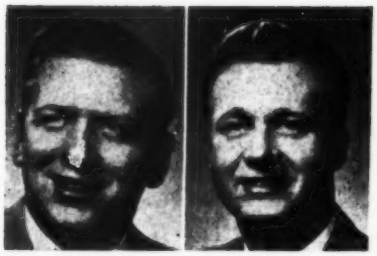
John R. Ryan has been appointed manager of explosives operations for Hercules Powder Company's Explosives department. At the same time, Edward L. Ramer was named manager of detonator operations. Both men were formerly in the Explosives department at the home office at Wilmington, Del.

Scovill Uses New Container

Continental Can Company has announced that Scovill Manufacturing Company is the first brass company to package copper-base-alloy wire in Continental Can's "Payoffpak" container. These containers hold about 300 pounds of brass wire which, in the lighter gages, is equivalent to 411,000 feet.

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .



Johnson Hesler

Industrial Filter & Pump Assigns Johnson and Hesler

K. C. Johnson has been transferred from the home office of Industrial Filter & Pump Manufacturing Company to the Pacific Coast as regional field engineer. He will work out of the company's Los Angeles and San Francisco offices.

In another change, Industrial named J. C. Hesler to its engineering staff as head of the Water and Waste Treatment division. Hesler is experienced in the water and waste treatment field.

Stone, Folger and Gavin Get New Assignments at Orbit

Earl N. Stone, Kansas representative for Orbit Valve Company in Tulsa since

Stone Gavin Folger

May, 1952, has been transferred to Denver. There he will represent Orbit in the oil fields of Colorado, southern Nebraska, Utah and northern New Mexico.

Charles J. Folger, formerly Orbit's Eastern representative at Newark, Ohio, has been transferred to Tulsa. He has been replaced by John J. Gavin, who will now serve as Orbit's Eastern representative from headquarters at Pittsburgh.

National Can Corporation Elects H. R. Baxter a Director

H. R. Baxter, vice president and treasurer of The Donner Corporation, has been elected to the board of directors of National Can Corporation.

The Donner Corporation is a private investment advisory company. Baxter has been identified with the investment business since 1924.

Burke and Muir Assigned to New Offices at Tube Turns

Tube Turns, Inc., has added Richard T. Burke, a sales engineer, to its Houston staff and assigned Earl R. Muir, Jr., a sales engineer formerly in its San Francisco office, to Seattle.

Burke, who joined the company in

For Trouble-Free Pipe Threading ...its a 65R RIDGID

This 65R threads 1" to 2" pipe with 1 set of dies ...and it won't jam!

You won't find a die stock to equal this popular 65R—anywhere! It saves time—one set of self-contained high-speed dies adjust to 1", 1¼", 1½" or 2" pipe or conduit in 10 seconds! Mistake-proof self-centering workholder sets to size instantly! It saves trouble—lead screw won't jam, it kicks out automatically when standard length thread is cut. Clean perfect threads, *fast!* For trouble-free extra-easy pipe threading buy 65R at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

RIDGID
Work-Saver Pipe Tools

For more data on advertised products, use Readers' Service Cards, last page.

Need RING GASKETS?

Call CHICAGO-WILCOX for PROMPT SERVICE

Since 1906, Chicago-Wilcox has served the refining industry with gaskets for every requirement. These A.P.I. ring gaskets are typical. Used on ring-type flanged joints in high pressure lines. Made of soft iron, standard steel alloys or any of the non-ferrous metals to any desired cross section.

Send specifications for quotations and prompt-delivery schedule.

CHICAGO-WILCOX MFG. CO.
2701 Avalon Avenue, Chicago 19, Ill.
Phone SAginaw 1-1900

See Page 235 in Refinery Catalog

Suppliers . . .

1949, was originally stationed at Midland, Texas. Muir, who joined Tube Turns in 1943, will expedite service to the company's Northwest distributors and to the area's users of industrial piping systems.

Cyrus Silling Will Manage Plastics Division at Witco

Witco Chemical Company has announced the appointment of Cyrus E. Silling, Jr., as manager of its Plastics Chemicals division with headquarters at the company's main offices in New York.

Silling

Silling joins Witco from the Ohio Apex division of Food Machinery & Chemical Corporation. Prior to that he had been associated with Hercules Powder Company. He received a B. S. degree from Carnegie Institute of Technology in 1944.

McClung Named Assistant At Alco Dunkirk Facilities

Appointment of E. R. McClung as assistant plant manager of American Locomotive Company's facilities at Dunkirk, N. Y., has been announced. Prior to this appointment, McClung was assistant manager of Alco's ordnance plant in Schenectady.

Galloup Made District Manager In Southwest for Edward Valves

Edward Valves, Inc., has announced the appointment of Rex E. Galloup as district manager for the Texas and Gulf Coast area. Edward is a subsidiary of Rockwell Manufacturing Company.

Galloup

As the company's district manager, Galloup, formerly sales manager for Oil Center Tool Company, Houston, will direct sales of Edward's new Mudwonder valve, which was designed particularly for mudline applications. His headquarters will be at 1601 Morst Street, Houston.

Mueller and Worthington Reach Agreement on Proposed Merger

Under an agreement reached between L. J. Mueller Furnace Company and Worthington Corporation, the net assets, name and goodwill of Mueller are to be transferred to Worthington in exchange for Worthington common stock. Preferred and common stockholders of Mueller Furnace Company will be called to vote upon and approve the proposal in a scheduled special meeting.

The Mueller plant and facilities would be operated as the Mueller Climatrol division of Worthington, and the entire working force of Mueller will be continued in its present form.

WIRE MESH

Jelliff

Specializing in the non-ferrous metals in counts to 200 x 200 or 50 x 750 and widths up to 48" in all commercial weaves

IN MESH WITH INDUSTRY

Since 1880

address your enquiries to Department 16

The C. O. JELLIFF MFG. CORP.
SOUTHPORT • CONNECTICUT • USA

WIRE PRODUCTS Jelliff SINCE - 1880

ELECTRO SNAP

Hermetically-Sealed LIMIT SWITCH

Type H

Designed and used for Military Aircraft. NOW . . . available for general Industry with the same QUALITY . . . the same precise SPECIFICATIONS . . . the same DEPENDABLE OPERATION in *any* environment!

GUARANTEED OPERATION in dusty, dirty locations, in intense heat (+250 deg.) or extreme cold (—100 deg.) Tipping action of the actuator insures positive, dependable operation even when the switch is *completely coated with ice* making this switch adaptable for unlimited refrigeration or out-door uses.

This switch is *truly the solution* to any application where environment is a problem. It is light, compact and easily mounted with a variety of circuit arrangements, including DPDT. Extremely long mechanical and electrical life . . . rated at 10 amps 125/250 V. ac.

Sealed Protection Against:

- Moisture
- Oil
- Dust and Dirt
- Heat and Cold
- Corrosion

For complete details . . .
WRITE TODAY for Data Sheet HN-4

see our catalog in Sweet's or write for copy

ELECTRO-SNAP SWITCH AND MFG. CO.
4224 West Lake Street, Chicago 24, Illinois

JET-LUBE
KOPR-KOTE
THREAD LUBRICANT and SEAL

BATCH CONTROLLED

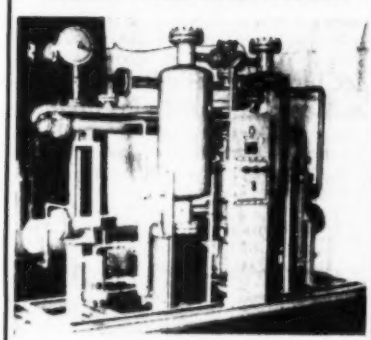
High temperature KOPR-KOTE with fine ground metallic copper, puts an end to leaks in casing and tubing. Hundreds of wells cased and tubed without a "leaker" using JET-LUBE'S KOPR-KOTE. Batch controlled. Unconditionally guaranteed.

Order through your supply store or send for complete details

JET-LUBE INC.

7362 W. BEVERLY BLVD., LOS ANGELES 36

Anders
FULLY AUTOMATIC
LIQUID PROPANE DRYER



100 GPM-LPG DRYER
now in operation at one of the larger Southwestern Refineries.

Let us send you our Bulletin No. 103 FAO with data on this and Reformer or HC Gas Dryers, also our Standard Instrument Air Dryers.

ANDERS LYKENS CORPORATION
LYKENS, PA.
Representatives in Principal Cities
Mfgd and Sold in Canada by
THE ARTHUR S. LEITCH CO., LTD.
Toronto 15, Ont.

Suppliers . . .

Nordberg Division Advances McCarthy to Sales Engineer

Appointment of Richard H. "Dick" McCarthy as sales engineer has been announced by the Heavy Machinery division, Nordberg Manufacturing Company. He will headquarter at Nordberg's branch office at Dallas, Texas.

McCarthy

McCarthy joined Nordberg Manufacturing Company in 1951 at Milwaukee, where he progressed through Production, Engineering, and Service departments, qualifying for assignment to the Sales department in June, 1953.

Company Changes

Wilbur E. Combs, formerly merchandising manager of New York Belting and Packing Company, has been appointed manager of sales development in the Mechanical Goods division of **United States Rubber Company . . . M. C. Minton Company, Ltd.,** Edmonton, Alberta, Canada, has been given franchise to sell **Jas. P. Marsh Corporation's** complete line in the Province of Alberta . . . **Robert W. Clyne,** formerly an officer and divisional sales manager of American Steel Foundries Company, Chicago, has been elected vice president-marketing of **Pressed Steel Car Company, Inc.,** located at Chicago . . . **Duncan W. Fraser** will retire as chairman of the board of directors of **American Locomotive Company** April 27. At that time the office of chairman will be discontinued. Fraser has been associated with the company continuously since 1901.

Horrall Harrington, an engineer in **Blaw-Knox Company's** Chemical Plants division, has been appointed sales engineer for the division's Midwest district . . . **I. W. Clark,** manager of the Heating and Ventilating department of **American Air Filter Company, Inc.,** has been elected president of the Industrial Unit Heating Association for 1954 . . . **Roger H. Bolin,** assistant to the vice president and general manager in charge of **Westinghouse Electric Corporation's** Consumer Products division, has been appointed manager of general advertising for Westinghouse. He succeeds Harry J. Deines . . . **Herbert Boshea,** formerly with General Electric Company, has been appointed purchasing agent for the Bridgeport Thermostat division of **Robertshaw-Fulton Controls Company.**

Joseph G. Holdenried, formerly vice president and general manager of **Daniel Orifice Fitting Company** of Los Angeles, has been elected president of the company, succeeding Paul P. Daniel, who will remain as chairman of the board. Other newly elected officers include **William Griffin, Jr.,** reelected as vice president; **Alphonsine Ring,** reelected as secretary-treasurer; **L. Waldo,** reelected as director, and **Kathleen**

Yes
SAND-BANUM
Pure Colloidal Concentrate

SAVES Power Plant Dollars
INCREASES Operating Efficiency
DECREASES Maintenance and Shut-Downs

Ounces Only Once A Week Remove and Prevent Boiler Scale

Its powerful yet gentle colloidal action is certain despite water or operating conditions. Harmless to personnel and equipment, you can use SAND-BANUM in absolute safety.

STOCKED BY
LEADING SUPPLY HOUSES
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Rockefeller Plaza
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Headquarters for
PETROLEUM TESTING EQUIPMENT
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• GASOLINE PLANTS

W. H. CURTIN & CO.
DOMESTIC EXPORT
LABORATORY APPARATUS & CHEMICALS
HOUSTON • NEW ORLEANS
TULSA • BIRMINGHAM • U.S.A.

Never before such response!

"Since we announced the new MCR fingertip control filter the response has been tremendous," says A. C. Kracklauer, president of Sparkler Mfg. Co. "Never before has the trade shown so much interest in the announcement of a Sparkler product."

Model MCR

60 second opening without disconnecting piping. Available in sizes from 100 to 2000 sq. ft. of filtering area. Filter cake can be removed in a semi-dry state by hand scraping or in some cases merely tapping the plates to let the cake fall into the portable disposal receptical.

One man can handle the complete cleaning operation in ten minutes. One movement of a handle to release head bolts, a flip of a switch and the tank moves back, stopping automatically, exposing the plates in less than 60 seconds. Pipe connections are all in the stationary head, so no disconnecting of piping is required. This gives you the fastest action, time-saving, labor-saving tank opening ever engineered in a filter.

Jet pressure spray tubes can be supplied in this filter for washing off cake or in combination with backwashing when the material filtered and sewer conditions permit this type of cleaning.

Filter tanks can be supplied in mild steel, stainless steel, Hastelloy or other metals to meet requirements.

Ten exclusive features

1. Large flow volume—large plate area up to 2000 sq. ft. and 1 ton cake.
2. One man fingertip operation.
3. No pipe lines to break in opening filter.
4. Filter seal of plates not broken in cleaning.
5. Self sealing cover gasket.
6. Dry cake disposal or flush down cleaning.
7. No head room required above filter.
8. Complete plate drainage.
9. Uniform precoating.
10. Quick opening cover.

European Plant: Sparkler International Ltd., Prinsengracht 876, Amsterdam, Holland.
Canadian Plant: Sparkler International Ltd., Galt, Ontario, Canada.

Suppliers . . .

Haney, assistant secretary . . . **Warren G. Kleban,** who has been active in the engineering and construction business for the past several years, has been named to head the new Starkville, Miss., branch office of **S. Schwartz & Associates,** consulting engineers.

Robert C. Brown, formerly purchasing agent for Jefferson Chemical Company, Inc., has been appointed division purchasing agent for the newly created Industrial Chemicals division, Purchasing department, of **American Cyanamid Company.** Jefferson Chemical is jointly owned by Cyanamid and The Texas Company . . . **E. L. Hamilton** has been added to the list of contractors who sell and apply the asphaltic protective coatings made by **The Insul-Mastic Corporation of America** . . . **Vapor Heating Corporation** and its subsidiary, Roth Manufacturing Company, have moved to new and larger quarters at 6420 W. Howard Street in Chicago.

Hutton Made Sales Engineer Of New Clark Sales Office

The opening of a new sales office at Shreveport, La., has been announced by Clark Bros. Company, Olean, N. Y. The new office has been opened to serve the compressor users of sections of Texas, Arkansas, Louisiana and Mississippi.

Hutton

James R. Hutton has been named sales engineer for the new office. Hutton was transferred from the Clark Houston office, where he had been employed for four and one-half years. To his new position Hutton brings much experience in all phases of compressor application.

McClure Succeeds Davidson As Carbide and Carbon President

Harry B. McClure has been appointed president of Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon Corporation. He succeeds Dr. J. C. Davidson, who becomes chairman of Carbide and Carbon Chemicals Company and a member of the Appropriations Committee of Union Carbide. Dr. Davidson is also a vice president of Union Carbide and Carbon Corporation.

Since June, 1953, McClure has been executive vice president of Carbide and Carbon.

Ulmer Succeeds Cross in Combustion Engineering Post

Combustion Engineering, Inc., has appointed R. C. Ulmer head of its Research department, succeeding B. J. Cross, who has reached retirement age and has been appointed research consultant. Since joining Combustion Engineering in January, 1953, Ulmer has been concerned with chemical problems of the Nuclear Energy division. Cross has been with Combustion Engineering since 1920.

Suppliers . . .

Carver Pump Elects Tanner Vice President, Sales Manager

Robert E. Tanner was recently elected vice president and general manager of Carver Pump Company, Muscatine, Iowa. He also assumes the post of general sales manager.

Tanner

Previously Tanner was engaged in sales work at Continental Can Company and at National Can Company, serving as vice president at the latter company.

He was graduated from the University of Minnesota in 1930 and was an All-American end there in 1929.

U. S. Steel Division Makes Field Organization Changes

The Oil Well Supply Division of United States Steel Corporation has announced the following changes in its organization:

In the Central Midwest area—promotion of William Robert Miller to field representative at Odessa, Texas; promotion of Roy V. Claytor to district representative, refinery and pipe line equipment sales at Hobbs, N. M.; appointment of Joseph R. Nye as field representative at Borger, Texas; appointment of Donald E. Kyle as field representative at Anson, Texas; and appointment of B. J. Travis as assistant district engineer, machinery and equipment sales and service, at Odessa, Texas.

In the Mid-Continent area—promotion of Elmer E. Stanley to field representative at Duncan, Okla.; promotion of Phil L. Lynn to field representative at Cushing, Okla.; and appointment of Doyle E. Richeson as manager of a new branch store at Lindsay, Okla.

In the Gulf Coast area—appointment of Hilliard L. Roberts as field representative at Lake Charles, La.

Robertshaw-Fulton Given Award

A certificate of cooperation has been awarded to the Robertshaw-Fulton Controls Company by the Mutual Security Agency "for furnishing technical assistance to the peoples of friendly countries." Highlighted with plant tours by industry teams from France, West Germany, England and Sweden, the program began in 1949 under the now-defunct Economic Cooperation Administration.

GUNITE
Since 1915
CONCRETE
SAND AND CEMENT
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We have a well trained and experienced field organization. We own and operate 43 complete cement gun outfits.

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No obligation

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2036 ADDISON, HOUSTON 25, TEXAS
St. Louis-Minneapolis-Denver-New Orleans

Betz Handbook Wins Award

W. H. and L. D. Betz's "Handbook of Industrial Water Conditioning" was awarded the "Best of the Year" citation at the recent 2nd Annual Printing Week Graphic Arts Exhibit held in Philadelphia. The handbook was chosen as the best designed and printed publication in its class during 1953.

Ryerson Becomes Distributor

Joseph T. Ryerson & Son, Inc., steel service organization, is now distributing plastic pipe and fittings produced by Carlon Products Corporation, Cleveland, Ohio. Ryerson has 16 steel service plants located in major industrial areas across the country.

PETROLEUM REFINER Classified Ads

RATES: Regular Classified (undisplayed) set in this size type; 10 cents per word. Minimum charge, $3. Blind box address in our care counts six words. Replies forwarded without charge. **Display ads,** set in suitably larger type with ruled border, $10 per column inch.

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HELP WANTED

TOP NOTCH REPRESENTATIVE

Preferably chemical engineer by training for firm of engineers and constructors to the petroleum and chemical industries. East coast location. Only man with record of achievement should apply. Our employees know of this advertisement, and all replies will be held in confidence. Box 182-R, c/o Petroleum Refiner, Houston, Texas.

Metal Inspector

An opportunity is open for a Metal Inspector, to take charge of Metal inspection program at our Sarnia, Ontario, refinery.

Engineering degree not essential but applicants must have several years' experience in inspection of refinery process equipment.

Write giving age, education, full details of experience, and salary expected.

Canadian Oil Refineries Limited
CORUNNA, Ontario, Canada

DESIGNERS

- *Piping*
- *Structural*
- *Electrical*

Work in the engineering of oil-refineries and chemical plants.

C. F. BRAUN & CO.
Engineers • Constructors
1000 SOUTH FREMONT
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U. S. Steel Supply Division Lists Area Personnel Changes

Promotion of Jon S. Blyth to assistant manager headed a recent list of personnel changes announced by the Eastern area of the Oil Well Supply Division of United States Steel Corporation. Blyth had been manager of the areas sales office at Pittsburgh.

In other changes, A. R. Nutter, office manager of the Columbus, Ohio, office, was named to succeed Blyth at Pittsburgh, and G. A. Yount of the area office staff was promoted to area office manager. James E. Goff, manager of "Oilwell's" branch store at Centralia, Ill., has been named field representative at Salem, Ill., and James E. McCaffrey, field representative, has been transferred from Pikesville, Ky., to Parkersburgh, W. Va.

For more data on advertised products, use Readers' Service Cards, last page.

NOW—

The Better to Serve Your Needs

DALMINE STEEL TUBING

Seamless Products—Carbon and Alloy

DALMINE, S. P. A.
MILANO, ITALY

CASING—TUBING—LINE PIPE

Dalmine is now producing P-110 pressure casing and tubing for your deep well requirements. Dalmine can provide all tubular products, including tubes for distilling, cracking, refining, hydrogenation, synthesis and processing. Made from carbon steel, chrome-molybdenum, stainless and other alloys.

A complete range of Seamless Steel Pipe—up to 34 inches O.D. in carbon and alloy grades.

Serving all of the tubular products needs of the oil, gas and refinery industries. Dalmine is an A.P.I. Licensee.

All tubing made in accordance with A.S.T.M. or A.P.I. specifications. Stocks maintained on Gulf and Pacific Coasts.

General Agents

CHARLES A. KOONS & COMPANY

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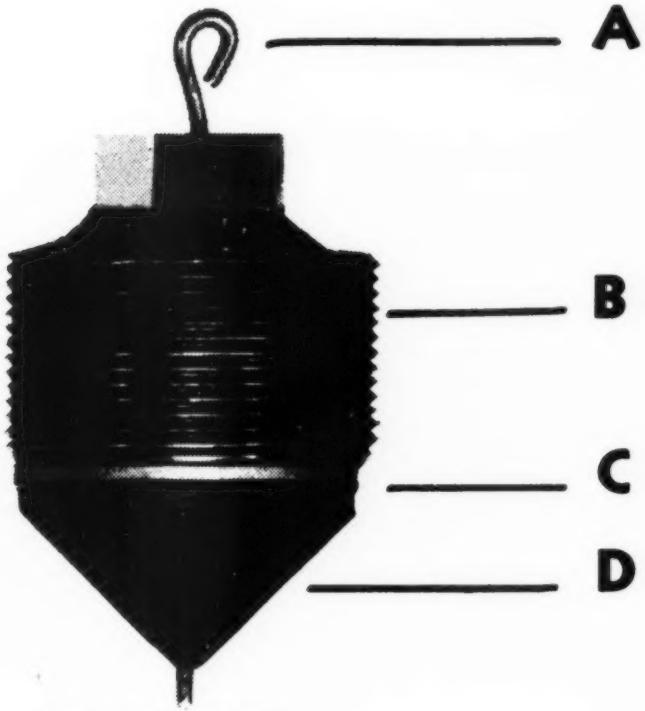
ROCKEFELLER CENTER
NEW YORK 20, N. Y.

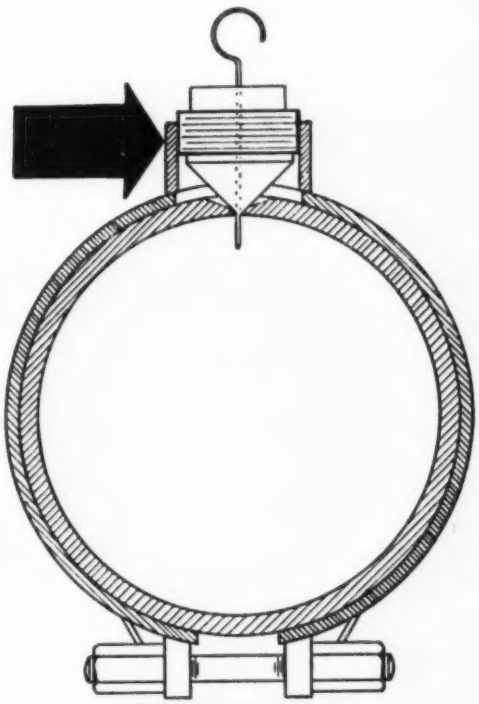
PLaza 7-4700

For more data on advertised products, use Readers' Service Cards, last page.

What's New in Equipment . . .



1. Heart of the Smith + Clamp.



2. Pipe line cross section.

Use This . . . **. . . Like This, and . . .**

Fix Those Pipe Leaks

Versatile pipe clamp permits plugging and welding pit hole leaks in pipe lines while pumping through it.

The Pipe Line Development Company now offers a new type of clamp for sealing off pit-hole leaks in piping. It is known as the Smith + Clamp. Because of the materials used in its sealing action, the clamp can be used for repairing leaks in lines carrying almost any type of fluids at pressures exceeding 2000 psi.

How It Works. The "heart" of the clamp is shown in Figure 1. The pilot pin (A), made of 1/16-inch diameter hard wire, goes down through the center of the force-screw (B) and the leak cone (D). This pin is free to move and serves to guide the point of the cone directly into the leaking hole. When turned with a wrench, the steel packing force-screw applies pressure directly behind the cone forcing it down against the hole. Additional wrenching pressure flattens the cone so that it flows out to fill in spaces between the pipe and the clamp. A thrust washer (C) allows the force-screw to turn without rotating the leak cone, which is made of high grade neoprene in the standard model.

How to Use It. Application of the clamp is simple and foolproof. It is applied by springing it apart and slipping it over the line to be repaired. The drawbolt on the clamp is then tightened to the point where the entire clamp fits the pipe loosely. The clamp is moved about so that the leak can be located using the pilot pin. The pilot pin is inserted into the leak hole and the force-screw is turned until the leak cone touches the pipe. Then the drawbolt is tightened securely. The pilot pin is removed and the force-screw is tightened until all leakage is stopped. See Figure 2 for a cross-sectional view of the clamp in position.

The Smith + Clamp is available in sizes to fit pipe from 4-inch through 30-inch. The leak cones are available in various diameters and various construction materials. The cones are made of neoprene normally, but can be made from silicone (for higher temperatures), teflon, steel and other materials.

The advantages of this clamp are:

- Low bolting pressure which allows its use in making repairs on corrosion-thinned pipe without danger of caving in the pipe walls.
- A sealing medium which is inert to

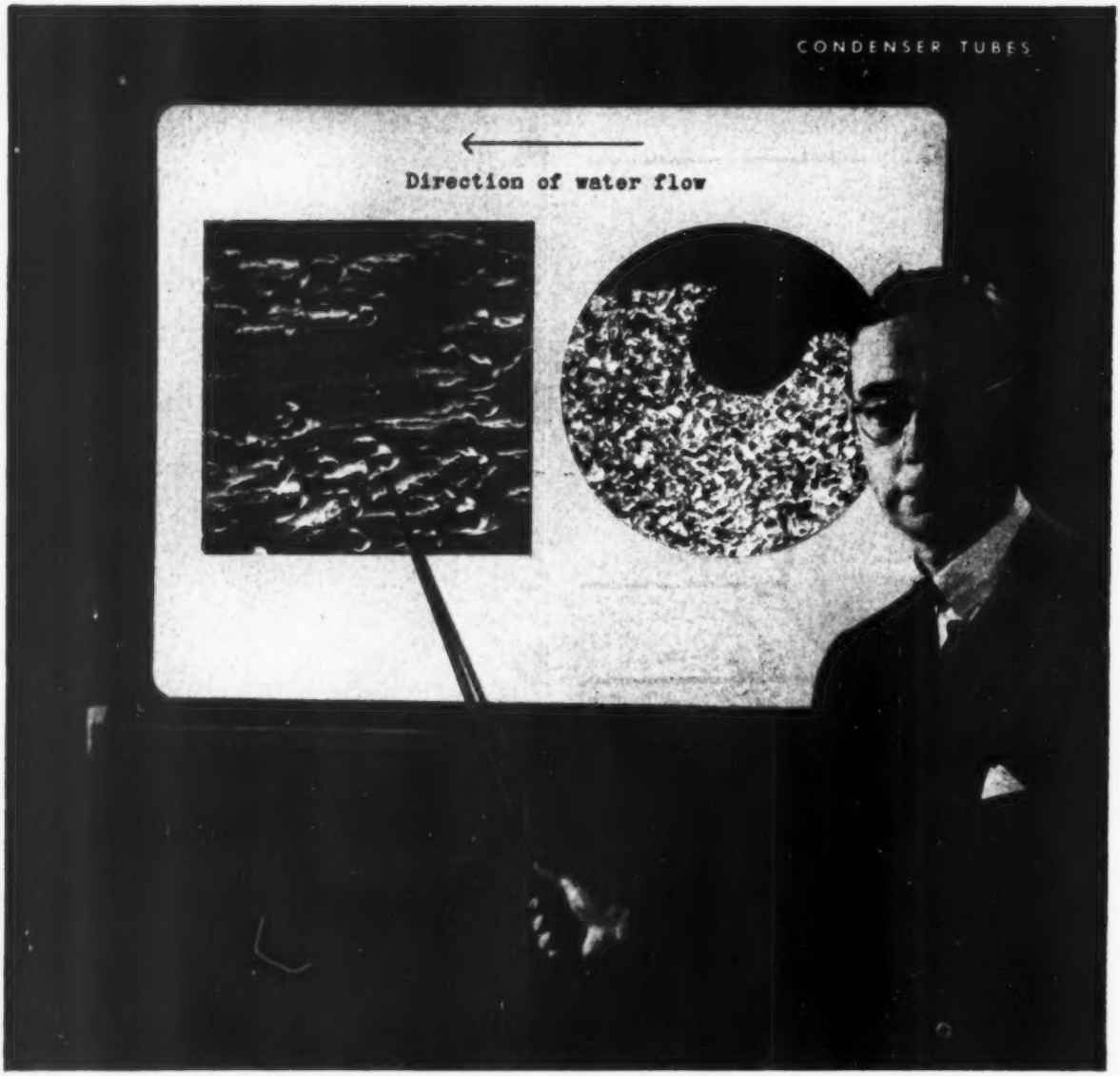


Illustration at left shows impingement corrosion of an Admiralty tube by high velocity sea water containing air bubbles. At right, longitudinal section through part of horseshoe-shaped pit is shown.

AIR BUBBLES: what causes them, how they affect condenser tubes

Before corrosion can occur, oxygen from the air dissolved in cooling waters must be present. But normally its presence doesn't cause *rapid* corrosion of condenser tubes.

What can cause rapid corrosion is air in the form of bubbles where turbulent flow is present. Whirlpools in the intake tunnel, leaky packing glands on pumps and at projections in injection pipes or water boxes may produce air bubbles of harmful size. Any condition that will produce a negative pressure at some point along a tube, such as a long outlet leg from a condenser, can cause air bubbles. Local pitting may then occur rapidly.

Air bubbles are only one factor affecting tube life. Publication B-2, "Anaconda Tubes and Plates for Condensers and Heat Exchangers," discusses *all* the important operational factors, and gives much other useful information. And, of course, our Technical Department stands ready to assist you in the selection of tube alloys from our extensive line. *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

54105

ANACONDA®

Tubes and Plates for Condensers and Heat Exchangers

Arsenical Admiralty-439; Ambraloy-927; Cupro Nickel, 30%-702; and other copper alloys.*

*U. S. Patent No. 2,003,685 (Orig.)

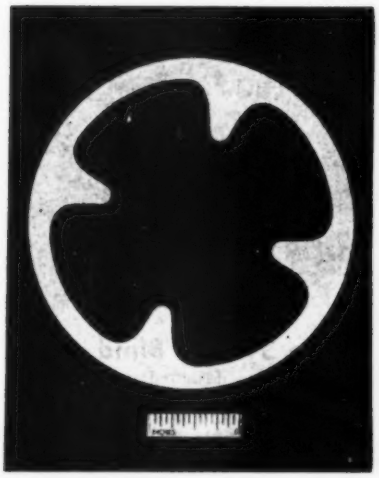
New Equipment . . .

any corrosive action from the fluid flowing through the pipe.

- Easy and fast positioning of the clamp over the leak.

The same company also manufactures weld plates which are designed for use with the Smith Clamp where codes require pipe reinforcement in the leak area. For more information about this equipment simply . . .

Circle E1 on Postcard



Internal Fin Tubing

Of particular interest to design engineers associated with unusual problems of heat transfer is tubing with integral fins on the inside surface. Such tubing is made possible by the extrusion process and has been produced by the Tubular Products division of Babcock and Wilcox Company. The tubing with ID fins, shown in the illustration, was produced by B&W of a special heat resisting stainless steel. The main feature of this type of tubing is, of course, the greatly increased surface area which permits a greater transfer of heat in a tube of any given length and diameter.

At present the production of such specialized tubing has passed the purely experimental stage and similar tubing can be produced of a number of steels in a limited size range. Additional information pertaining to special tubular shapes produced by extrusion is available now.

This item supplements Babcock and Wilcox Company data on pages 149-152 of The Refinery Catalog, 21st Edition.

Circle E2 on Postcard

Rotary Joints

Key Company is now making available to the refining and petrochemical industries a new ball and socket type rotary joint. Designed to permit transfer of liquid or steam into or out of any revolving unit, this socket is available in either the thru-flo style, for drums having two outlets; or in the siphon style, or installations where inlet and outlet is deired in the same unit; or for siphon drainage of condensate

Yours
. . . for the asking.

BURGESS-MANNING
Explosion Resistant
SNUBBERS

Three Grades of Silencing . . . with ONE GRADE of quality—the FINEST! Burgess-Manning Snubbers offer *these features* in ALL THREE SERIES!

EFFICIENT MECHANICAL DESIGN—the result of over a quarter century of solving surge and noise problems.

PROVEN PRINCIPLES—perfected through sustained research.

BUILT LIKE PRESSURE VESSELS—explosion-resistant . . . rugged . . . trouble-free.

FLEXIBILITY OF INSTALLATION—inlet types to fit any condition with the greatest possible efficiency and economy.

Send for NEW ENGINEERING DATA CATALOG TODAY.

BURGESS-MANNING COMPANY

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DALLAS, TEXAS

Sound Engineering

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For more data on advertised products, use Readers' Service Cards, last page.

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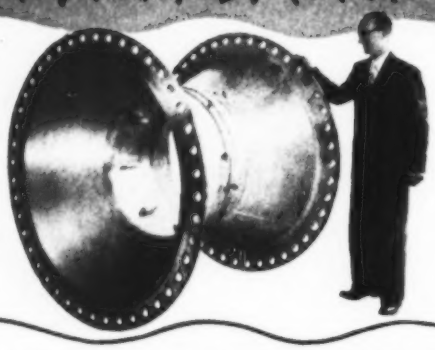


only the Gentile FLOW TUBE manufactured by FOSTER offers you all these ADVANTAGES:*

*Gen-til-ly

ACCURACY — Produces differential from points of equal cross-sectional area . . . furnished with head capacity curves, and guaranteed for exceptional accuracy when used with any standard indicating, recording or integrating meter.

LOW HEAD LOSS — Available in several types and D/d ratios to provide differentials that can be accurately measured with least head loss.

LOW INSTALLED COST — Average length is only 1½ times the pipe diameter, and straight runs entering and following are not required unless installed near throttling valves or regulators.

Write for Bulletin FT-101 or specific recommendations

75 YEARS OF PROGRESS

FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE — UNION, N. J.

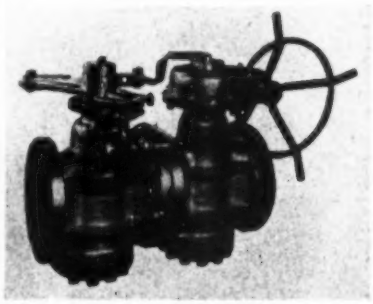
AUTOMATIC VALVES • SAFETY VALVES • FLOW TUBES

New Equipment . . .

from the steam chambers of the roll or drum. These new rotary joints are stocked in pipe sizes ranging from ¼-inch to 3-inch, and larger sizes are available on special order. A bulletin illustrating both types of joints and some typical installations is available now.

This item supplements Key Company data on pages 519-522 of The Refinery Catalog, 21st Edition.

Circle E3 on Postcard



Piping System Blind

A new blind designed to increase the safety and simplicity of mechanical blinding operations in fluid product piping transfer systems has been introduced by Rockwell Manufacturing Company. the Rockwell line consists of two straight way Nordstrom Hyperseal valves butted together in series and operated in unison through a common linkage. A bleeder valve, located between the two Hyperseal valves, is operated through the same linkage in such a way that when the two block valves are turned to the closed position the bleeder is automatically opened. A few of the many features of this new blind are:

- Precise piping alignment unnecessary to prevent binding in the blind.
- Prevents pressure build-up in LPG service.
- Tamper proof locking device.
- Simple one wheel operation.

Complete data on this new product is available now.

This item supplements Rockwell Manufacturing Company data on pages 645-652 of The Refinery Catalog, 21st Edition.

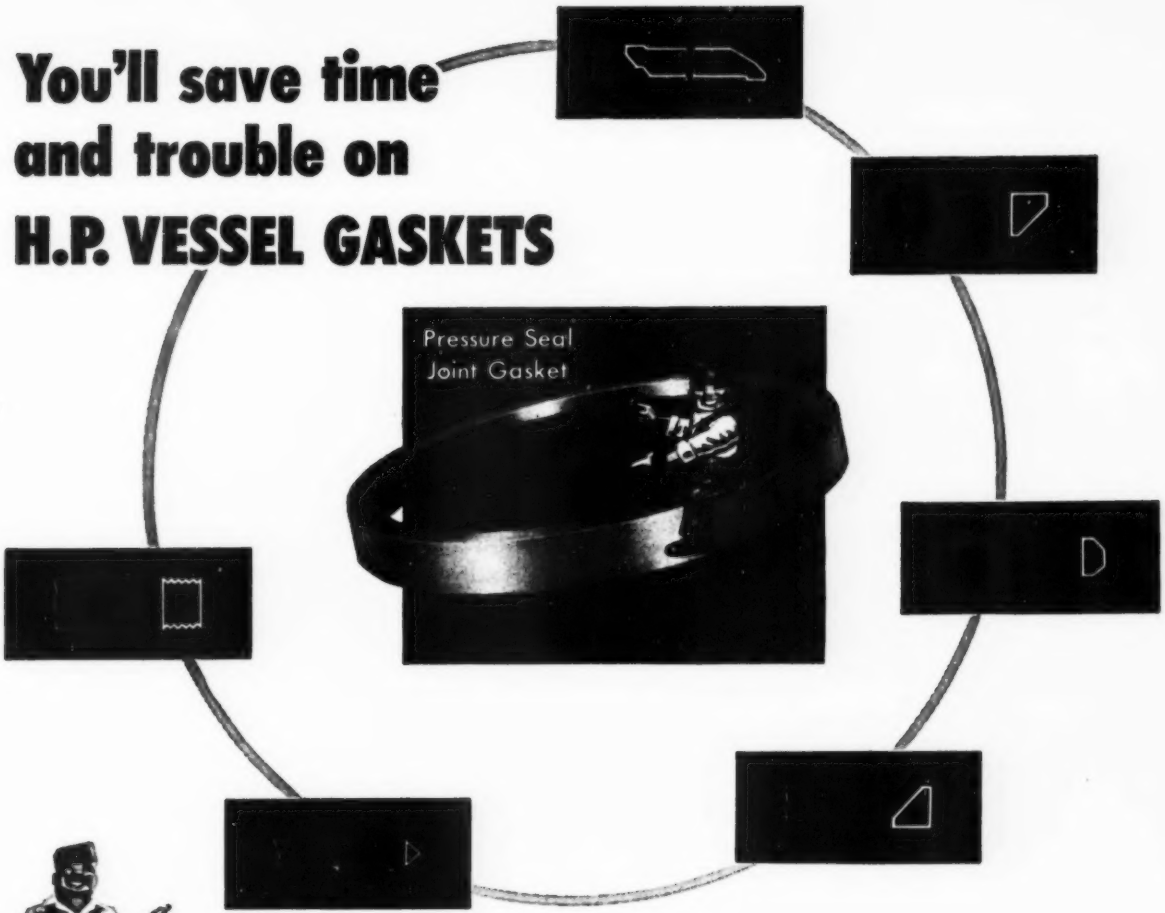
Circle E4 on Postcard

Tank Cleaning Method

Dowell, Inc., has introduced a new method of cleaning storage tanks with chemical solvents. Applicable to almost any type of tank cleaning problem, this method replaces sand-blasting and mechanical scraping.

Basically, the system is this: Thickened chemical solvents are sprayed onto tank surfaces, reaching rivets, seams, and irregularities that are inaccessible to mechanical cleaning methods. After completion of chemical reaction, they are flushed off by means of high pressure sprays. Metal surfaces can then be given a spray treatment to prevent after-rusting. This new chemical cleaning technique has reduced cleaning time

You'll save time and trouble on H.P. VESSEL GASKETS



...when J-M Goetze gasket specialists make them for you

When you need gaskets such as those above, which were made for pressure vessel service over 5000 psi, consider this. It takes less time and trouble to turn the job over to J-M Goetze —an organization that has specialized in gasket design and manufacture for 67 years. And it usually costs less in the long run.

Goetze engineers can select the right style for maximum sealing efficiency. They know the correct metals and other factors required for efficient, long-lasting gaskets.

Goetze Gaskets are made exactly to the last detail of your specifications and conditions. They are made to craftsmen's perfection . . . with modern machine tools, some of which were specially designed by Goetze for gasket manufacture.

If you need gaskets for high pressure vessels or similar applications, send us a drawing or template for quotation. Or write for further information to Johns-Manville, Box 60, New York 16, New York.

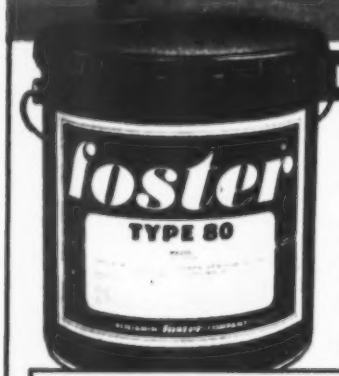
Johns-Manville *Goetze* GASKETS

THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE

For more data on advertised products, use Readers' Service Cards, last page.

FIRST

and the Only One!



FOSTER'S TYPE 80 MASTIC

the first and only Mastic with the UNDERWRITERS' LABORATORIES ***label classification: as to*** FLAME SPREAD • FUEL CONTRIBUTION ***and*** SMOKE DEVELOPED

Safety Engineers. Chemical Engineers. Plant Maintenance Superintendents. Architects and many other top-flight executives have wanted this: a Mastic that gave complete protection against corrosion, rust and weathering

Plus

providing a dependable moisture vapor barrier

Plus

an UNDERWRITERS' LABORATORIES listing of classification...

and here it is!

FOSTER'S TYPE 80 MASTIC

There's plenty more to be said about the outstanding features of this Fire-Resistive TYPE 80 MASTIC... all yours, for the asking.

Contact our nearest representative (we have National Representation) or write to our Manufacturing and General Offices.

© B. F. CO.

The Benjamin **foster** Company

4635 W. Girard Ave., Phila. 31, Pa.

New Equipment...

from days to hours. A few of the features of this new cleaning method are:

- Saving of time.
- More thorough cleaning.
- Prevention of after-rusting gives better paint job.

For complete information on this new solution to your tank cleaning problem, just . . .

Circle E5 on Postcard

Non-Ferrous Hoist

A new 1-ton chain hoist is now being made available to the refining and petrochemical industries by Ampco Metal, Inc. This new unit was developed to meet the demand for a non-magnetic, spark-resistant hoist for use in locations where standard chain hoists constructed of ferrous materials have proven unsuitable. This hoist of the spur-gear, ball bearing type, is recommended for use in hazardous areas where a spark might cause an explosion and where corrosion might result from direct contact with liquids or fumes. All cham used in these new units is proof tested at 4000 pounds and the hoists themselves are tested to 50 percent over their rated capacity before delivery.

Send for complete details on this unique hoist.

This item supplements Ampco Metal, Inc., data on pages 133-136 of The Refinery Catalog, 21st Edition.

Circle E6 on Postcard

New Recording System

Capable of continuous logging conditions found in multiples of 48 to 144

AIRCO HELMETS: A complete line of helmets and face shields in a wide variety of styles and types. In any kind of service, these Airco products provide the greatest possible operator safety and comfort.

AIRCO HOLDERS: Famous Jackson jaw-type and Martin Wells screw-type holders. Nineteen Jackson models, from 200 to 500 amperes. Six Martin Wells, including the Heavy Duty Model 6S — the only holder on the market that will handle 700 amperes!

AIRCO GLOVES: The same quality that makes other Airco accessories the best value you can buy extends to welders' gloves and leather sleeves.

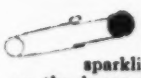
AIRCO CABLE AND CONNECTIONS: Unrivalled dependability, long life and flexibility. Sizes from 4 to 4/0, for wide range of amperages at varying distances from welding machine. Make sure of good connections with Airco ground clamps, cable splicers, Quik-Trik cable connectors and cable lugs.

RELY on AIRCO quality in both fields

... And soapstones, tip cleaners, clamps, circle cutting attachments, carrying cases, carbon pencils, carbon torches, graphite electrodes, chipping hammers, brushes . . . you name it — Airco has it at low prices. Call your Airco dealer or write us directly for your copy of Catalog 13, "Airco Welding Accessories," and complete price list.

AIRCO GOGGLES: for gas welding or cutting. Precision made, they afford excellent ventilation with maximum eye protection. All types exceed National Bureau of Standards requirements.

AIRCO CYLINDER TRUCKS: Make your welding and cutting outfit easily portable with an Airco two-wheel hand truck. Strong, rigid, welded steel frame; broad steel platform. Five models offer wheel sizes and styles for every type of surface.



AIRCO SPARKLIGHTERS: Save time and trouble with the standard Airco sparklighter and its replaceable round file, or the heavy-duty Airco Tri-Flint model, which carries three flints in a rotating holder.

AIRCO TWIN-HOSE: Two lines of hose moulded into a single, light, flexible unit. Close, tight braid permits thicker rubber cover for greater wear resistance.

AIR REDUCTION MAGNOLIA COMPANY

A Division of Air Reduction Company, Incorporated

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AN AIR REDUCTION PRODUCT

at the frontiers of progress you'll find

Southwestern Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Welding and Cutting Machines, Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

INSULATION SPECIALISTS SINCE HALF A CENTURY

We supply the material and the men to handle it.
Contractors for heat and cold insulation all over the world.
Suppliers and exporters of all kinds of insulation materials for oil refineries a.o.:

Magnesia 85% - Rockwool - Asbestos - Cork

For all temperatures, in sections, blocks, segments, sheets, blankets and plastic form.

All finishing materials.

INTERNATIONAL TECHNICAL TRADING COMPANY **CLETON LTD.**

SCHIEDAM - NETHERLANDS
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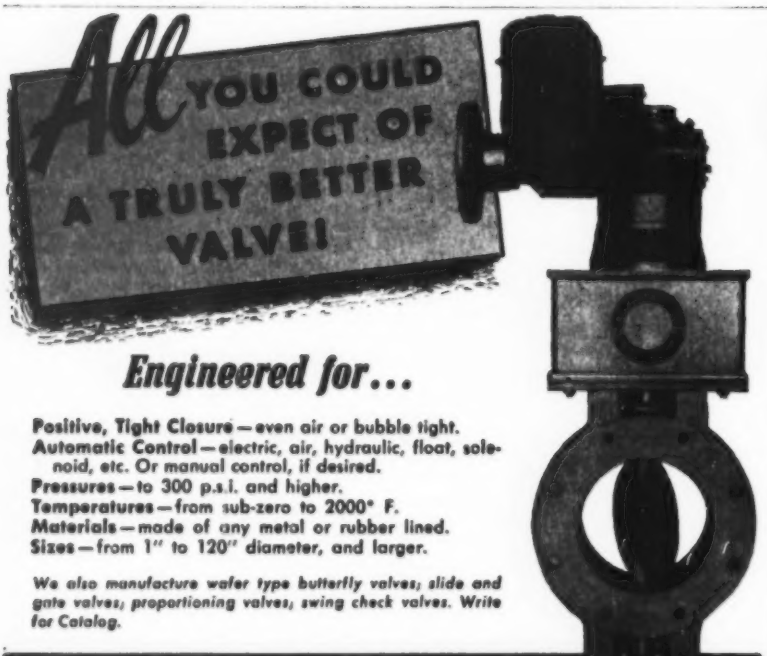


Engineered for...

Positive, Tight Closure—even air or bubble tight.
Automatic Control—electric, air, hydraulic, float, solenoid, etc. Or manual control, if desired.
Pressures—to 300 p.s.i. and higher.
Temperatures—from sub-zero to 2000° F.
Materials—made of any metal or rubber lined.
Sizes—from 1" to 120" diameter, and larger.

We also manufacture wafer type butterfly valves; slide and gate valves; proportioning valves; swing check valves. Write for Catalog.

W.S. ROCKWELL VALVES

W. S. ROCKWELL COMPANY
2504 Eliot Street • Fairfield, Conn.

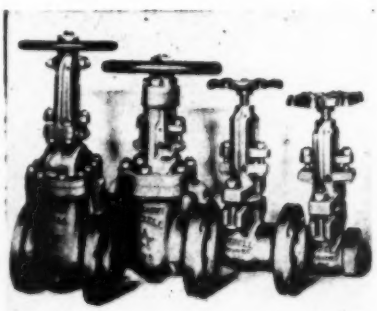
Butterfly valve with outboard roller bearings, electric motor operator and auxiliary handwheel control, for high velocity air at 125 p.s.i. and temperatures from minus 20° to plus 200° F.

New Equipment...

points, at the rate of a point every 1 to 5 seconds, a new recording system has been developed by the Industrial division, Minneapolis-Honeywell Regulator Company. This new multipoint logging system was especially designed for testing in research applications where a record of all measurements was required. It has a single set point as contrasted to more expensive elaborate electronic systems. The new system includes a strip chart recording instrument, a junction box which functions as a control center for the system, and up to three switching units. Each switching assembly controls two banks of thermocouple points (24 points to a bank). Also incorporated in the system is a signal alarm unit which provides a signal light when an abnormal condition exists and which remains on until reset manually. The instrument may be stopped on any one point and utilized as an indicator recorder, recording that point continuously. Complete details of this new system are available now.

This item supplements Minneapolis-Honeywell Company data on page 596 of The Refinery Catalog, 21st Edition.

Circle E7 on Postcard



NI-Resist Valves

The William Powell Company is now making available a new line of valves that will be of special interest to the refining and petrochemical industries. Known as Powell NI-Resist Valves, they are specifically designed to check the high cost of corrosion. These new valves are especially adapted for oil refinery acids, alkalies, and sludges, caustic soda, sea water and many other fluids commonly encountered in the industries.

Complete information is available on this new line of valves now.

Circle E8 on Postcard

Infra Red Analyzer

Liston-Becker Instrument Company is announcing the addition of the first commercially available dual infra red analyzer to its line of Infra Red instrumentation. This dual analyzer provides, within a single unit, continuous analysis for two components in a complex gas stream. Because of unique design, the cost and complexity is only slightly greater than Liston-Becker's single component instruments. The dual analysis is obtained by cascading detectors sensitized with the different gases. One fea-

From Atomic Research

COMES FASTER... MORE ACCURATE

measurement of percentage hydrogen in liquid hydrocarbons . . . . . .

Here is an instrument that utilizes the absorption of beta rays as a means of measuring the percentage of hydrogen, or the hydrogen-carbon ratio, in liquid hydrocarbons. Now . . . for the first time . . . research men, product control engineers, and others can obtain a quick, accurate determination in five minutes instead of the four hours required by combustion train methods. Furthermore the measurement is made with an accuracy of 0.02 weight percent hydrogen as compared with the usual 0.05 weight percent hydrogen.

The new Cenco Beta Ray H/C Meter has numerous applications in petroleum processing . . . in refining operations where the hydrogen-carbon ratio is altered . . . where the percentage of hydrogen is an index to the performance of end products, as fuel oils, jet fuels, gasolines, etc. Full details about this modern precision instrument are contained in our Bulletin No. 115. Write for your copy today. Exclusive manufacturing and sales rights for the Cenco Ray H/C Meter have been assigned to Central Scientific Company by Standard Oil Company (Indiana).

The NEW cenco® Beta Ray H/C Meter utilizes radioisotopes

Our 14 branch offices and warehouses assure prompt service and shipment of laboratory apparatus and supplies.

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CENTRAL SCIENTIFIC CO. OF CANADA, LTD. (and Hendry Division)
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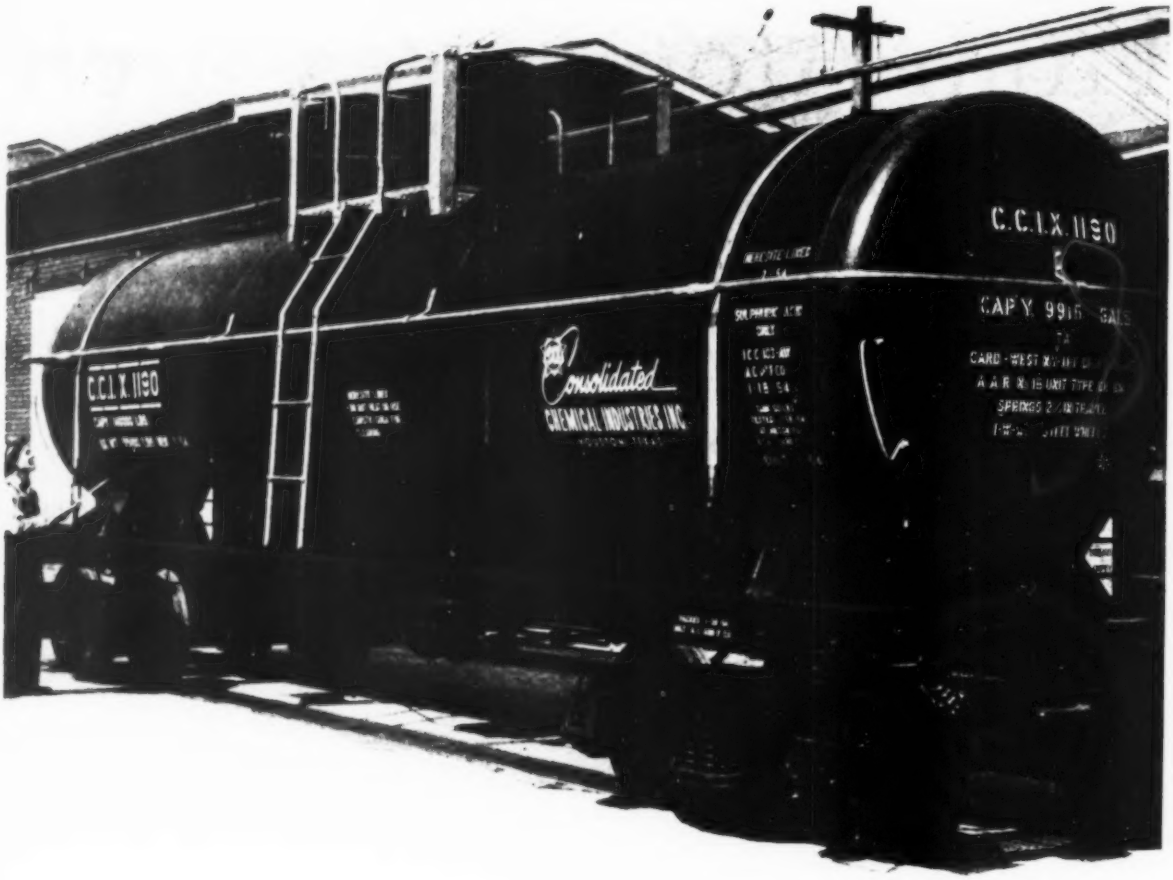


..What will you do with the sludge acid ?

You will load it right back into the tank car, if you are one of a growing number of users of Consolidated Sulphuric Acid who are contracting with us to regenerate their sludge acid.

In this way, the many problems of sludge acid disposal are eliminated—There is no problem of air or stream pollution—There is no troublesome equipment maintenance problem... concentrators and separators can be eliminated—There is no capital investment problem.

If you have to dispose of large quantities of sludge acid, check with us. The chances are, we can work out a mutually profitable contract to regenerate all your sludge, thereby relieving you of disposal problems.

CONSOLIDATED CHEMICAL INDUSTRIES INC.

640 ESPERSON BLDG. HOUSTON, TEXAS

For more data on advertised products, use Readers' Service Cards, last page.

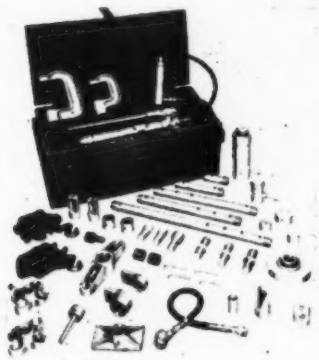
New Equipment . . .

ture of this new instrument is that only one amplifier is employed. Among the other features are:

- Printing speeds as fast as 6 seconds.
- Cost saving in both first cost and in maintenance.
- Results may be presented on any of the standard multi-point potentiometer recorders.
- Available with explosion-proof pick-up and remote recorder controls.
- Either automatic or manual standardizing accessories are available.

For complete information on this new instrument, simply . . .

Circle E9 on Postcard



Hydraulic Equipment

Black Hawk Manufacturing Company is announcing a new super maintenance assortment of its hydraulic "Porto-Power" equipment. Designed for industrial maintenance and construction work, this 46-piece assortment is the latest in remote-controlled hydraulic jacks and attachments for pulling gears, moving machinery and hundreds of other maintenance jobs.

One hydraulic pump, with swivel connected coupler, serves the four hydraulic rams in the set. These four rams are: a midget 4-ton ram which lifts from a low of $1^{11}/_{16}$ inches, a 7-ton short ram, a 10-ton general purpose ram, and a heavy duty 20-ton ram. Forty-one selected attachments adapt these rams to literally hundreds of pushing, pulling, lifting, clamping, spreading, bending and pressing jobs. This maintenance assortment includes newly developed "lock on" tubing connectors and adapters.

For complete details on this equipment, just . . .

Circle E10 on Postcard

Induction Motors

A complete new line of alternating current squirrel cage induction motors was recently announced by Allis-Chalmers Manufacturing Company. The new motors (designated type G) will retain all of the important features of Allis-Chalmers' "AI" line while offering certain other improvements inherent in the re-design.

Under the new standards, the 5 hp. 1800 rpm motor will be on the 215 frame. None of the performance standards will be altered, and the perform-

Here's

Practicality!

PATTERSON

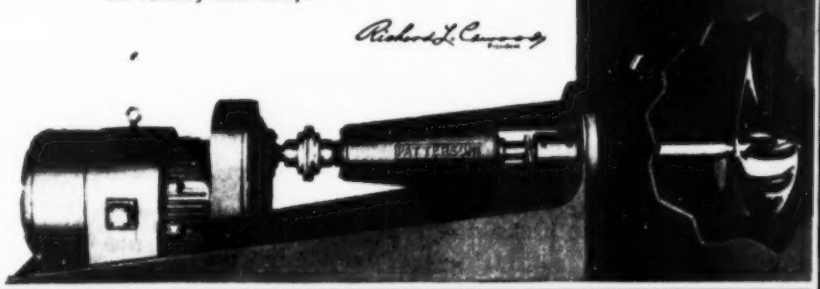
Outside Packed

SIDE ENTER AGITATORS

no lost running time

A unique method - a unique advantage - thanks to Patterson ultra-modern design! No special tools required - any handyman can change packing while agitator is in full operation. Send for full details on these versatile, dependable Patterson Agitators that handle so many jobs - so well - in the refining field today!

Richard L. Conway



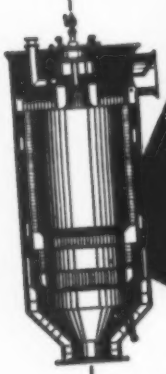
The Patterson Foundry and Machine Company

East Liverpool, Ohio, U. S. A.

The Patterson Foundry and Machine Company, (Canada) Limited

Toronto, Canada

PEABODY WELCOMES ANY PROBLEM



...requiring high-temperature controlled-pressure atmospheres

With more than 30 years of successful experience in designing combustion systems for pressure and other types of firing, Peabody delivers better-than-specified performance on all Direct Fired Air Heater installations.

Compact, flexible and custom-engineered to the job, Peabody Air Heaters can be used throughout industry on such typical installations as:

Spray, tunnel, compartment, rotary kiln and cylinder drying: as well as Odor Abatement, Annealing, Stress Relieving, Catalytic Cracking and Liquid Concentration.

If you have a problem of either product or process refinement that lends itself to pressure firing, we'll be glad to help solve it at no obligation.

PEABODY ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N.Y.
Manufacturers of all types of combustion equipment, direct fired air heaters, gas scrubbers, coolers and absorbers

764

OFFICES IN PRINCIPAL CITIES
PEABODY LIMITED • LONDON, S.W.1, ENGLAND

Write for Bulletin 600-D

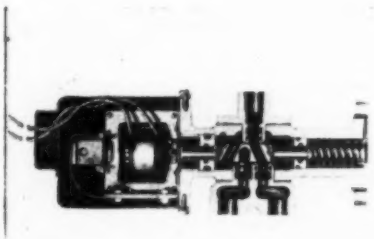
New Equipment . . .

ance in the re-rated frames will be within the limits of present values.

These new motors will be initially available in frame sizes 182 and 184. Larger frame sizes will become available at approximately five-month intervals. The information that you need for your application is available now.

This item supplements Allis-Chalmers Manufacturing Company data on pages 97-104 of The Refinery Catalog, 21st Edition.

Circle E11 on Postcard



Solenoid Valves

A new series of valves, designed for 0 to 250 psi industrial oil service, is now available from Barksdale Valves Company. Incorporating the shear seal principle, these valves are not critical to pipe scale or other foreign material in the liquid because the lapped sealing members are in constant intimate contact. The design of these valves allows the square corner wiping action of the shear seals to push dirt aside and let it flush out through the return port. Because flow is through the sealing members and never across the sealing surfaces, erosion and scoring are prevented. These new valves in ½-, ⅜- and ¼-inch pipe sizes are now available in four-way, three-way, and shutoff models for 120, 220, or 440 volts a.c. To get the information that you need for your applications, simply . . .

Circle E12 on Postcard

Correct Name of Pump

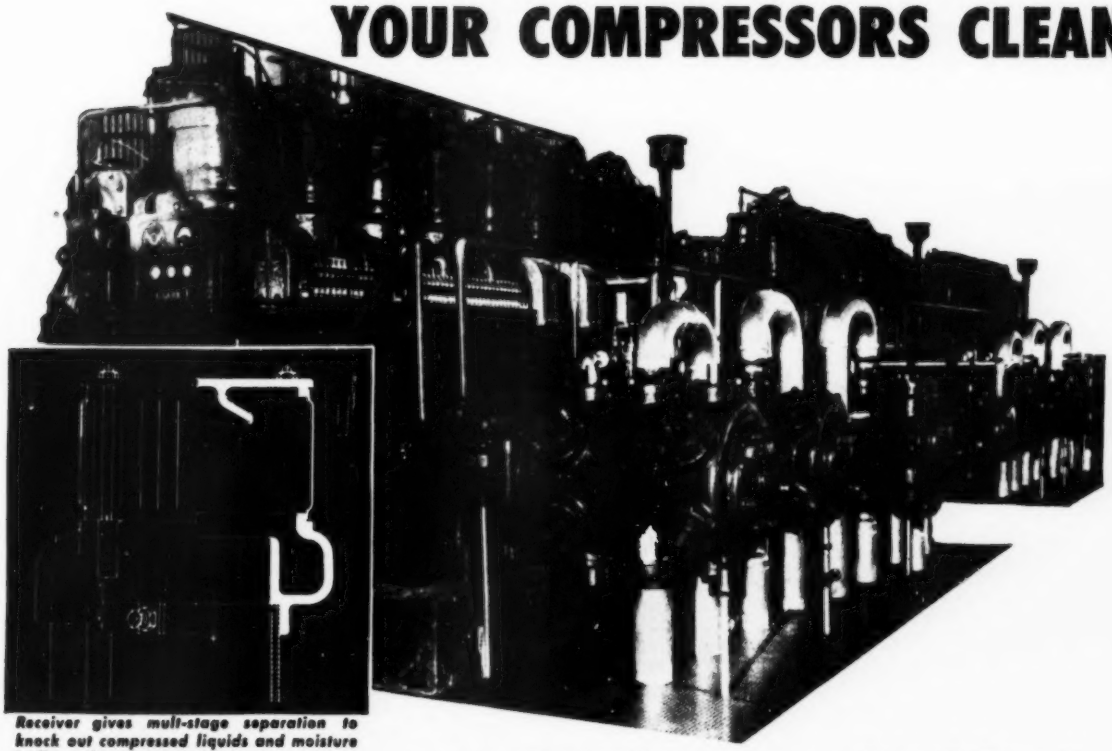
National Carbon Company's new series of impervious graphite centrifugal pump sizes and types is known as "Karbate," instead of as incorrectly announced in item No. 18 in the January issue. National Carbon, a division of Union Carbide and Carbon Corporation, makes Type C and Type F pumps for application in the refining and petrochemical industries wherever pumping conditions are corrosive to ordinary iron and steel.

Features of the new Karbate pumps: capacities from 5 to 1500 gpm at discharge pressures up to 1000 psi; mechanically sealed with enclosed cooling; SN armored connections; maximum interchangeability of parts; and pump efficiency up to 60 percent.

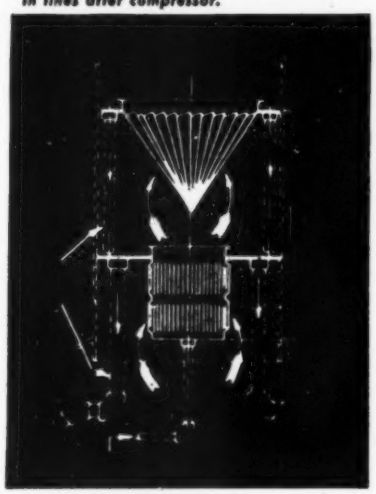
This item supplements National Carbon Company data on pages 758-759 of The Refinery Catalog, 20th Edition.

Circle E13 on Postcard

we're scrubbing petroleum gases to keep YOUR COMPRESSORS CLEAN



Receiver gives multi-stage separation to knock out compressed liquids and moisture in lines after compressor.



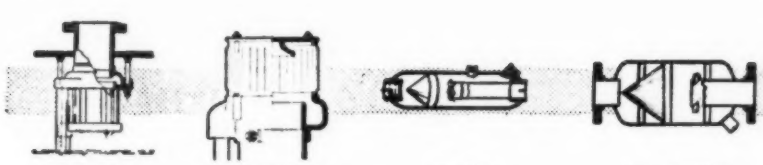
Two-stage scrubber separator uses solvent contact 1st stage and centrifugal application 2nd stage.

● Centrifix Scrubber Purifiers are designed for compressor protection in refinery and gas transmission pumping station operation. Two-stage wet and dry separation removes dust and sticky hydrocarbons. Efficiencies of over 99.9% with total solids held to less than 1 ppm have been realized, affording extraordinary protection to equipment.

Keep lines clean and dry with Centrifix Receivers on the compression side. They knock out compressed liquids and moisture with efficiencies of over 99.5%.

Centrifix Purifier designs are engineered to meet the operating requirements of your equipment. Pressure drop is held to your specifications. Centrifix Purifiers contain no moving parts and provide self cleaning action, hence require no maintenance.

WRITE FOR CENTRIFIX ENGINEERING BULLETINS FOR PERFORMANCE FACTS



FD UPFLOW FR DOWNFLOW RA LINE RW HD LINE

THE Centrifix CORPORATION
3608 PAYNE AVENUE
CLEVELAND 15, OHIO

For more data on advertised products, use Readers' Service Cards, last page.

Hartzell Cooling Tower Fans Handcuff These Thugs

Corrosion, abrasion and vibration can't get the best of a fan with Hartzite plastic blades. That's why these thugs steer clear of a cooling tower or heat exchanger equipped with Hartzell fans.

Hartzite blades absorb vibration, resist abrasion and are unaffected by most industrial acids, mild alkalies and weather. Even when the surface of the blade is damaged, you're not in trouble—the interior has the same high resistance to corrosion and mechanical damage.

Nearly every Hartzell fan installed since the introduction of the Hartzite plastic blade in 1941 is still in service today. Where one Hartzell has been installed on a battery of cooling towers or heat exchangers, "Hartzell" is invariably specified as additional fans need replacement.

For more details on how Hartzell, "the" cooling tower and heat exchanger fan of the petroleum industry, can handcuff the cooling tower thugs who have been causing you trouble, write today for your free copy of Bulletin A-111.

HARTZELL *propeller fan co.*

Div. of Castle Hills Corp.

Name _____

Company _____

Street & Number _____

City & State _____

If student, check here for special information ☐

Dept. R

PIQUA, OHIO

PROPELLER-TYPE FANS • BLOWERS
ROOF VENTILATORS • UNIT HEATERS

ENGINEERING OFFICES IN PRINCIPAL CITIES

What's New in Manufacturers' Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

Glove Selector

Of particular interest to operating, personnel and safety departments will be the newly designed industrial glove selector now available from Surety Rubber Company. The selector shows at a glance the correct glove for every industrial need by rating the gloves according to their resistance to various kinds of destructive chemicals. The information contained on the compact pocket-size slide chart is based upon laboratory tests (pressure needle and emersion) and extensive user experience. The slide chart which measures 8½ x 3 inches shows how each type of Surety industrial glove stands up against more than 70 different kinds of acids, oils, solvents, chemicals, abrasives, and natural elements.

To obtain information regarding its availability, simply . . .

Circle E14 on Postcard

Chemicals Bulletin

A new 33-page technical bulletin describing ethylene oxide, ethylene glycol, and diethylene glycol has been released by Nitrogen division, Allied Chemical and Dye Corporation. The bulletin describes fully each chemical, giving its uses, chemical and physical properties, handling and storage features and safety precautions. The behavior of each of the materials with other chemicals is portrayed by complete reaction formulas. The book also gives complete analytic procedures to follow to determine color, odor, acidity, impurities, specific gravity, etc. Charts showing equipment for unloading tank cars and graphs pertaining to safety, humectant values, dew points, specific gravity, vapor pressure, and other characteristics are included in this well illustrated bulletin.

For your copy of this very informative bulletin, simply . . .

Circle E15 on Postcard

Automatic Burner Bulletin

Peabody Engineering Corporation is now offering a new bulletin on its automatic burner model PK-54. This bulletin completely illustrates the new burner and lists its many features. For your copy, simply . . .

Circle E16 on Postcard

Pump Brochure

The Roy E. Roth Company announces the publication of a new 24-page brochure dealing with the special design of regenerative turbine pumps available for service in the refining and petrochemical industries. In addition to giving both illustrations and specifications of the company's pumps, the booklet contains an original approach to NPSH, together with full data on the use of this concept in selecting turbine pumps for service in our industry. It also contains a survey in evaluation of a variety of mechanical seals available in pumps. To receive your free copy of this most informative brochure, simply . . .

Circle E17 on Postcard

Chemical Index

A 304-page catalog with a listing of 7344 laboratory chemicals has been published by Fisher Scientific Company. Included in the chemical section are: a comprehensive line of individually lot analyze reagents; bacteriological culture media; fluid extracts, spirits, tinctures; radio-active reagents; and analytical ion exchange resins. The new index gives structural formulas, molecular weights, melting points and boiling points for most of the chemicals and color index numbers for dyes and stains. Designated catalog number 115-C, it is available without charge now. Just . . .

Circle E18 on Postcard

Insulation Manual

A new 20-page technical data manual has been published by American Gilsonite Company. The manual describes the three grades of Gilsulate, a new insulation for hot underground pipes. Numerous charts, tables, drawings and graphs are used throughout the manual to simplify and clarify engineering calculations. In addition, information is given as to how ditch sizes are determined for various pipes and types of soil, how the efficiency of Gilsulate is calculated, and how the performance for Gilsulate for a particular job can be predicted.

For your copy of this informative manual, simply . . .

Circle E19 on Postcard

Castings Slide Chart

A Lebanon Circle (L) slide chart giving facts on steel casting material selection has been developed recently by Lebanon Steel Foundry. This new slide chart gives reference data on 19 carbon and low alloy grades and 17 stainless and corrosion resistant grades which are in regular production at the Lebanon Foundry. In addition to the Lebanon designation, the chart also gives the comparable ACI, AISI, ASTM, Hydraulic Institute, SAE, U. S. Military and Federal designations where applicable.

For a quick and easy reference and assistance in speeding and simplifying your selection of materials, get this new slide chart now. Simply . . .

Circle E20 on Postcard

Thermometer Catalog

A new 44-page catalog on remote bulb thermometers is now available from Minneapolis-Honeywell Regulator Company. Also covered in the catalog are recorders, indicators, pneumatic controls, electric controls, psychrometers, bulbs, tubing and fittings. This completely illustrated catalog also gives information on applications, methods, and selection data.

To receive your copy, simply . . .

Circle E21 on Postcard

Control Valve Catalog

Hammel-Dahl Company has just made available a 76-page catalog describing its automatic control valves and other automatic control equipment. Included in this booklet are engineering descriptions and cutaway drawings. Each automatic control valve is discussed from the viewpoint of applications, design features, construction features, and standard specifications. Many types of control valves are covered for a wide variety of applications. In all, there are 13 bulletins in the catalog. One of these bulletins contains engineering data. This bulletin includes valve sizing charts and practical examples of the solution of valve sizing problems for both gases and liquids. To obtain your copy of this informative catalog, simply . . .

Circle E22 on Postcard

Turbine Catalog

The whole new line of D-H turbines is described in catalog number 500 now offered by Dean Hill Pump Company. This flexible-covered, 16-page publication furnishes complete data on the improved D-H horizontal and vertical turbines which were recently redesigned. All of the new design changes, which, incidentally, provide up to 100 percent more horsepower on some models, are incorporated in the new catalog. To get your copy, simply . . .

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Circle page number for more information on ADVERTISED products

PETROLEUM REFINER Readers' Service Card — **April, 1954, Issue***

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293a	293b	294	295	296a	296b	297a	297b	297c	298	299	300a	300b	300c	301a	301b	301c	301d	302	303
304	306	307	308a	308b	309	310	311	312a	312b	313	314	316	317	318					

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44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
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293a	293b	294	295	296a	296b	297a	297b	297c	298	299	300a	300b	300c	301a	301b	301c	301d	302	303
304	306	307	308a	308b	309	310	311	312a	312b	313	314	316	317	318					

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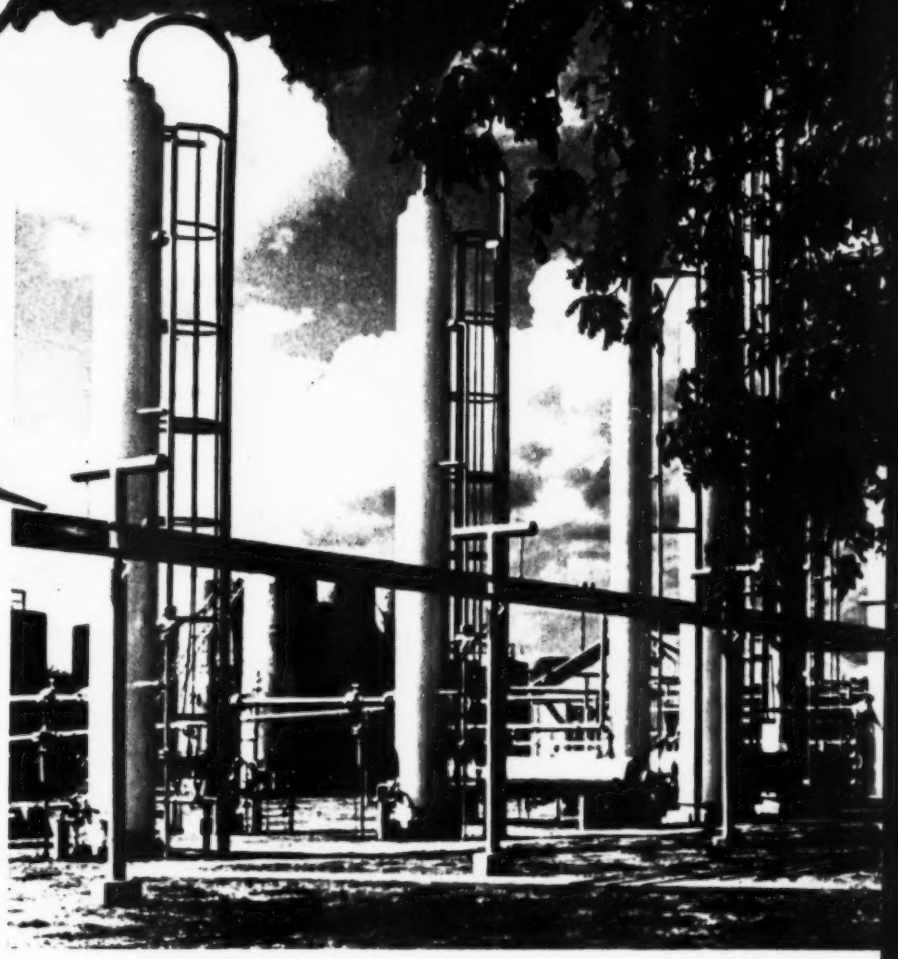

• Whenever the oil search comes up with a major strike of condensate, recovery must take place on the spot and the industry widens its processing skyline by calling for the skill of Wyatt fabrication.

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Plate 824 — Special All-Bronze Double Swing Joint. Sizes: ¾ to 1¼ inches.

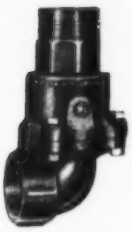

Plate 983 — Single Master Swing Joint. Sizes 1½ to 3 inches.

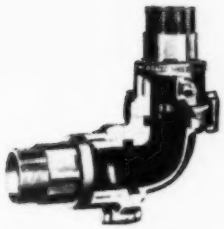

Plate 984 — Double Master Swing Joint. Sizes: 1½ to 3 inches.

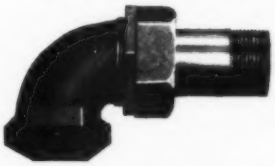

Plate 823 — Special All-Bronze Single Swing Joint. Sizes: ¾ to 1¼ inches.

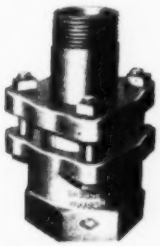

Plate 889 — Straight Standard Swing Joint. Sizes 1¼ to 4 inches.

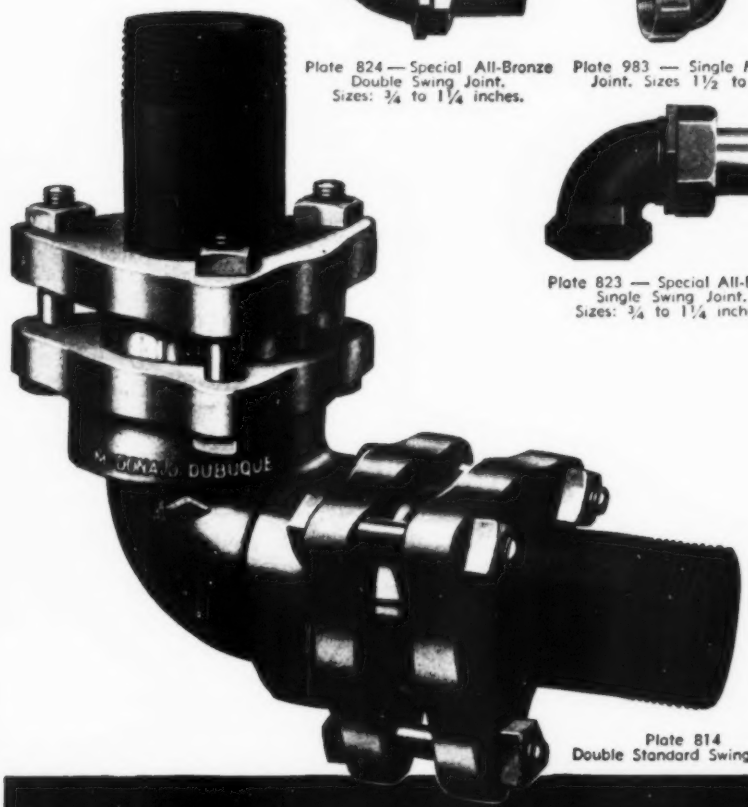

Plate 814 Double Standard Swing Joint.

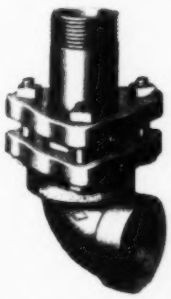

Plate 813 — Single Standard Swing Joint. Sizes: ¾ to 10 inches.

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